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LACHINE RAPIDS AT WORK.

The inauguration last Saturday of the great power plant at Lachine Rapids, near Montreal, is one of the most important happenings in the industrial developments of Canada. When the early French *voyageurs* found their passage up the St. Lawrence stopped by the turbulent current of these rapids, they selected a site nearby as that of their depot of supplies, and the beginning of the portage around the rapids to the upper regions of the river and the Great Lakes. These natural conditions have caused the largest city in Canada to be built at this point, and now, after many years in which the rapids have stood as a barrier to navigation and as a hindrance to the development of that part of Canadian territory, they suddenly find themselves in the service of the very city whose existence they called into being.

There is nothing remarkable about this plant, except its great size. The electrical engineering features, as may be gathered from the description in another part of this issue, are of a very conservative type, and do not mark any departure from currently accepted practice. The hydraulic engineering features are of the most daring kind, and many woeful predictions have been made concerning the stoppage of the plant by anchor ice and the backing up of the tail water by ice gorges. The only way to test the truth of prophecy is by waiting, and it is likely that the experience gained this winter at Lachine will settle the question of the operation of low-head water powers in a high latitude in the manner most to be desired. It is greatly to be hoped that this great undertaking will prove the financial and engineering success which the courage of its promoters deserves.

Perhaps the most interesting feature about the future programme of the company vending the power from these rapids in Montreal is its intention to enter the field of domestic heating in competition with anthracite coal at about $6 a ton. It is confidently claimed that, with the very cheap power available, electric heating can be popularized at prices comparable to those now paid for coal heating with its attendant nuisances. At any rate, the experiment is to be tried on a scale hitherto unapproached, and in a climate which, should it prove successful, will demonstrate the efficacy of this means of heating beyond all doubt.

A theoretical determination of the heat obtainable from coal and from electrical energy indicates that the rate per kilowatt hour will have to be made extremely low to compete with coal at such a price. Anthracite coal gives off in burning approximately 15,000 British thermal units per pound. Allowing for a loss of 50 per cent. from incomplete combustion and flue losses, electrical energy would have to be sold at the rate of fifteen-hundredths of one cent per kilowatt hour to make the cost per heat unit the same as that derived from $6 coal.

This rule applies, of course, only to general atmospheric heating. When heat is desired locally, as in a cooking utensil, the case is quite different. The electrically generated heat can be produced just where it is wanted, and inside a protective lagging, if desired. The ordinary kitchen range is a remarkably inefficient piece of apparatus. In common practice it burns some 25 to 50 pounds of coal per day, enough to evaporate hundreds of pounds of water, or

to raise to the boiling point thousands of pounds. Almost all of the heat generated is wasted in atmospheric dissipation. The advantage of a heating utensil wherein the heat can be internally instead of externally applied is obvious. While it is hardly to be hoped that the Lachine plant will make Montreal a "smokeless city" in winter, as some have imagined, it seems reasonable to look forward to a time when coal will not be used there for power purposes or for such local heating as falls within the proper province of electricity.

CONCERNING THE DONKEY PUMP.

It is not an uncommon sight to see a large generating station equipped with high-class steam machinery and striving for the highest economy in operation by the use of elaborate steam-saving devices, condensers, economizers, etc, furnished with boiler-feed pumps which consume about 150 pounds of steam per horse-power hour. This is the kind of economy that calls to mind a variety of proverbs, conspicuous among them one concerning the spigot and the bung-hole. The large source of waste in pumps of this character is frequently sufficient to bring the operating economy of the plant down to a point which is surprising alike to engineer and financier.

The plain and effective remedy for this trouble is the use of electric-motor driven pumps, which operate at an efficiency quite approaching that of the main generating plant. Such pumps have already come into use in many of the best-designed plants, and there is no reason whatever why their use should not become practically universal in electrical-generating stations. In point of cost they compare quite favorably with the ordinary duplex-plunger steam pump, while repairs on them are both less frequent and less expensive. Their perfect control, the automatic methods that may be readily adapted to them, their high efficiency compared with other forms of boiler-feeding pumps, are all points which should be carefully considered by those designing steam plants for electric supply. To-day the only leak of any importance in the ordinarily well-designed station is in the pumps, and it would be a matter of interest in many stations showing only fair economy where a better performance could be looked for to compare the present cost of producing a given result with that which would follow the installation of electric pumps. The donkey pump, while probably the worst offender of its kind, is not the only auxiliary common in steam plants to which electric motors may be applied with satisfactory results. A case in point is described in this issue in the article on the steamer Kaiser Wilhelm der Grosse, on which sixteen forced-draught blowers are operated by electric motors.

AN ACCIDENTAL OPPORTUNITY.

The total destruction by fire on Wednesday evening of this week of the large central power station of the Capitol Traction Company, of Washington, D. C., presents another object lesson in mechanical traction methods and an excellent opportunity for electrical engineers. While the misfortune which has befallen the owners of this unlucky plant is much to be deplored, it is to be earnestly hoped that the opportunity now presented for the electrification of the extensive cable system operated from this plant will not be lost.

The system operated from this power plant comprises the larger part of the cable railways in the District of Columbia, and the two great arteries of traffic, Fourteenth Street, running north and south, and Pennsylvania Avenue, running diagonally across the city, are absolutely cut off from transit facilities by the destruction of this plant. Those who know the great size and massive character of cable machinery will readily appreciate the fact that it will take a long time to get the plant running again, even under temporary conditions. It is highly probable that, with the conduits already in place for cables available, this company could put in an underground electric system, and have it in operation long before it could by any possibility replace the enormous special machinery required to drive its cables.

A very interesting contrast is that between this catastrophe and a similar one which befell the electric-power station of the Philadelphia Traction Company's lines last March. The delay in the case of the Philadelphia railways was about six hours. While it is, of course, impossible to say definitely at this time how long the delay will be at Washington, it will likely be about six months. The establishment of an electric system on these lines would be of great benefit, not only to the company controlling them, but also to the citizens of Washington, since an accident such as that which has taken place would no longer be a possibility, and the total stoppage of the traction systems in the heart of the city would never again be feared.

GOVERNORS AND ALTERNATORS.

The water-wheel governor has long been a serious factor when water power was used for dynamo driving, because of the inability of the governor to manipulate the gates with sufficient promptness under changes of load. This difficulty seems to have been met satisfactorily in many recent types of governors by the application of the relay principle. One peculiarity of the relay governor is that its control is isochronous. This very virtue makes trouble when it is used on alternators worked in multiple.

Two alternating-current dynamos working in parallel force each other to run in mathematically exact synchronism. The effect on the governors is the same as though their respective water wheels were rigidly coupled to one shaft. Under this condition, if the critical speed of one governor is ever so little less than that of the other, it will shut the water off from its wheel until the other wheel is overloaded at full open gate and dragged down by the overload to the critical speed of the slower governor.

In some large long-distance power plants, in which the single transmission line necessitates parallel running, each dynamo in service, with one exception, is worked on fixed gate, the exception being governed to take up the load fluctuations. This is a very unscientific makeshift, and dangerous as well, unless some automatic provision is made against runaways, which are sure to occur in case the load falls below the power delivery through the fixed gates. A better arrangement is to control all the gates from the relay of one governor. This not only insures an equable distribution of the load at all outputs, but also avoids the danger of runaways.

Patent Practice Purified.

The Secretary of the Interior has approved the action of the Commissioner of Patents in disbarring John Wedderburn and John Wedderburn & Co., of Washington, from practising before the Patent Bureau.

This action is the result of a long and thorough investigation of the methods pursued by Wedderburn & Co. The charges against the firm were of unprofessional conduct, deception of clients and the use of inefficient employees in their business. The firm has advertised extensively, and from time to time has published letters recommending it, purporting to be signed by Senator Gorman, former Vice-President Stevenson and other public men. It has offered prizes for competitive inventors, and advertised to distribute more than $1,800 a month to meritorious designers.

The firm has so increased its business as to employ more than a hundred clerks in Washington, and there are few towns that have not seen its attractive advertisements. The firm made an elaborate defence before the Patent Office, but the Secretary has decided finally that it has been guilty of unprofessional conduct. The most conspicuous example of the "Inventor's Journal" extant was a publication of this firm, and has an enormous circulation.

The Lachine Rapids-Montreal Electric Power Transmission System.

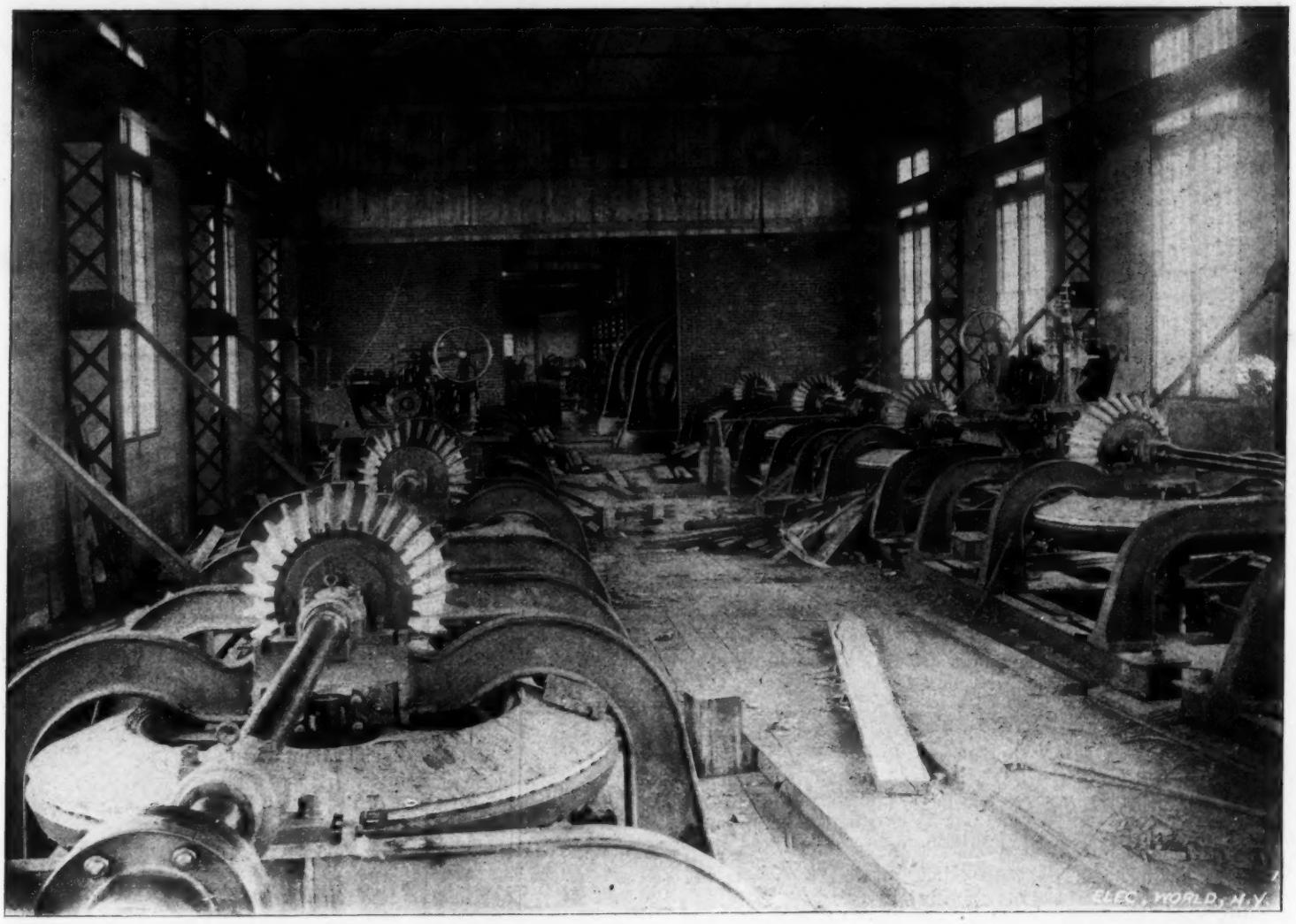
LACHINE Rapids, in a certain sense, made Montreal. The St. Lawrence, navigable for 600 miles from the sea for large vessels, here descends a chain of turbulent rapids, and here Jacques Cartier halted in his attempt at a westward passage to China. Three hundred and sixty-two years later the rapids, which mark the head of navigation and determined the position of Montreal, are harnessed for the service of the city which has grown up below them.

The scheme of obtaining power from these rapids is by no means a new one, having been proposed and forgotten a dozen times within the century. It was not until the perfection of electrical transmission methods, however, that work was seriously begun.

In 1895 the Lachine Rapids Hydraulic & Land Company commenced the construction of the great water-power-development works at the rapids, and, after exploiting a project for the direct utilization of the power at the wheels, decided to transform the whole output of their plant into electricity, and transmit it to Montreal, or elsewhere, as might be profitable. The engineering work done under the auspices of this corporation is bold to a degree, being in some respects without precedent, and both its financial and engineering promoters are worthy of the greatest credit for their persistence in the face of many natural obstacles and much adverse criticism.

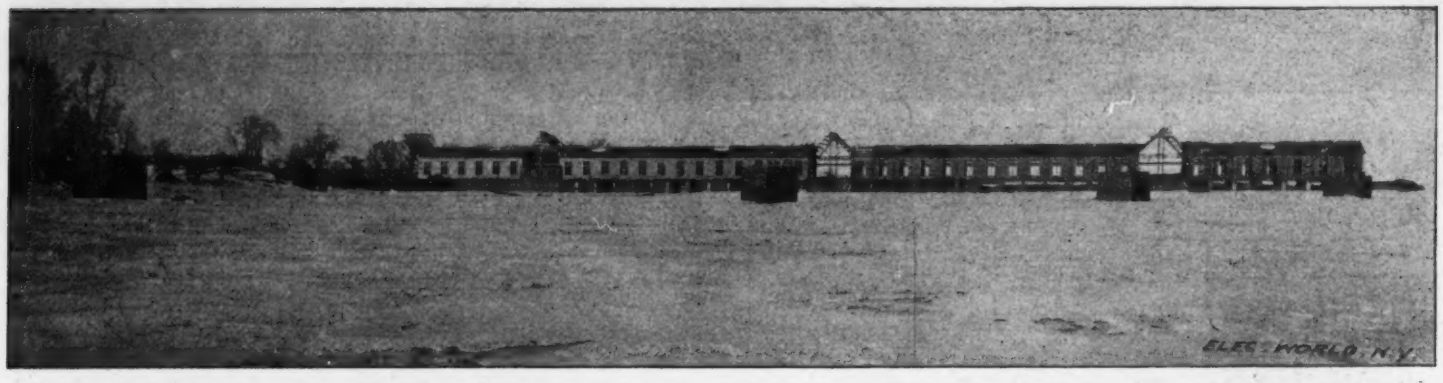
The Lachine rapids are divided into two channels by an island, the Isle au Héron, and the smaller division, on the left, or Montreal side of the St. Lawrence, was chosen for the scene of the power development. Here, in the current of nearly 15 feet per second, a dam, parallel to the shore and about a mile long, was constructed, and the channel thus formed blasted out and deepened. The dam is, for the most part, built of 12x12-inch timbers, filled with boulders. Its facing is of two thicknesses of 3-inch plank, with broken joints, and in general cross section it is square. The crest is sloping and is topped with heavy hemlock logs, squared on three sides, the fourth side, with the natural curvature of the tree, being uppermost. At the upper end of the channel, between the dam and the shore, which is about 1000 feet wide, a number of heavy piers support a boom to deflect floating ice into the main current of the rapids. The wing dam ends in a granite pier adapted for ice breaking, and built of heavy stones, solidly keyed together by a peculiar construction.

At a point about 1200 feet from the lower end of this artificial canal a cross dam of dressed stone 1000 feet long serves to give the necessary difference in level, and to contain the whole of the hydraulic machinery. Upon this is built the power house, which is probably the largest structure of its kind. This building consists of three dynamo rooms and four rooms for the wheel gearing, the whole being 1000 feet in length, 61 feet wide at the dynamo rooms and 40 feet wide at the other portions. It is solidly built of steel beams, having brick walls in the dynamo portions and a corrugated iron exterior with a lining of heavy felt and a ceiling of matched boards in the other parts. The roof is ceiled inside throughout and slated for its whole length. The floor is of steel I beams and concrete covered with one-inch slate slats in the dynamo rooms, and heavy boarding in the connecting portions.



INTERIOR OF ONE OF THE GEARING ROOMS, SHOWING GOVERNORS.

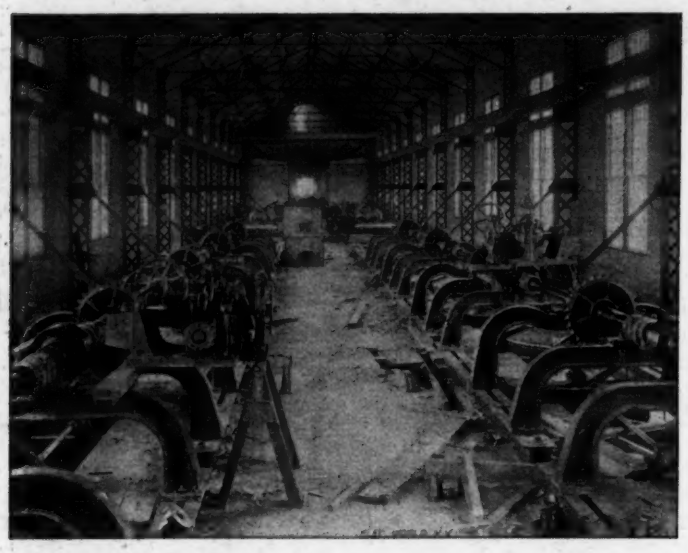
The seventy-two turbines are of the vertical shaft pattern, each 57 inches in diameter, and giving, at 83 r. p. m., with the normal head of 16 feet, 300 horse-power each. Six of these are attached by bevel gearing to each of the twelve horizontal dynamo shafts. The wheels are of a submerged type, having cylinder gates and no draft tubes. The massive bevel gearing consists of a steel pinion on the dynamo shaft and a crown gear on the wheel shaft, provided with maple



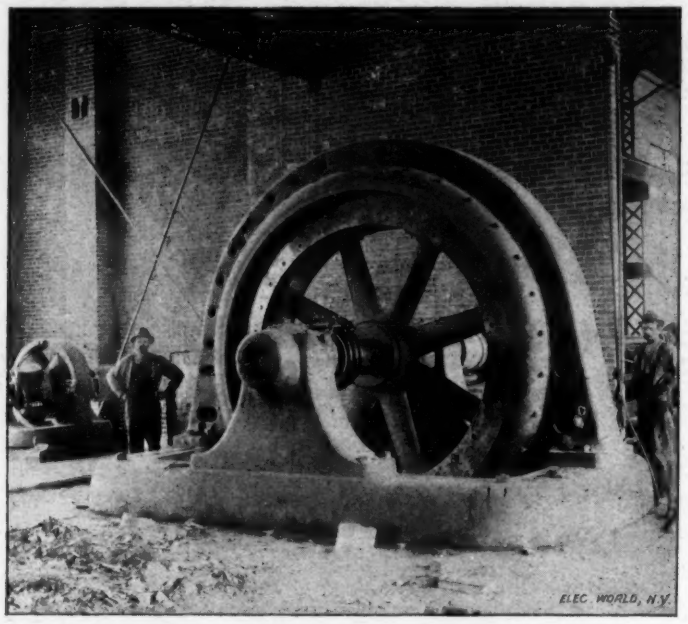
A Winter View of the Uncompleted Power House from the Forebay.

teeth, the combination proving very effective and singularly quiet in operation. The most interesting feature of the hydraulic plant, however, is the governing mechanism, one governor controlling each gang of six wheels.

A sensitive ball governor is operated at a high speed by a belt from the main shaft. This controls a scale-beam lever, having at each end an electrical contact and steadied by a small alcohol dash pot. The electrical contacts control two powerful electromagnets adapted to move a pair of friction discs, keyed on the main shaft,



Looking Down the Power House from the Centre.



One of the 750 kw 4400-Volt Dynamos.

to the right or left. These engage with other friction discs, to which are connected a powerful screw gearing which controls, through a system of levers, the cylinder gates of the six wheels. These gates are counter-weighted to decrease the effort necessary for their control. The governor will shut off all the water from full head in nine seconds, and under ordinary running conditions is almost as as perfect in its control of the wheels as the best types of steam engine governors. These machines, as well as the wheels and gearing, were made and installed by the Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, to whom much of the credit for the successful performance of the plant belongs.

The dynamos are to be twelve in number, although only four are now in operation. These machines are of the revolving field type, and are rated at 750 kw each. They are wound for three-phase current at 4400 volts direct from the armature, and operate at a periodicity of 60 cycles per second at their normal speed of 175 r. p. m. An exciter is provided for each machine, consisting of a 40-kw four-pole generator, giving 150 volts at 875 r. p. m. These are belted from pulleys on the main shaft, and the four for each group of four dynamos are worked in parallel. These exciters also furnish current for the electrical governors previously mentioned. Both dynamos and exciters were built at Peterborough, Ont., by the Canadian General Electric Company.

The permanent switchboards, of which there will be three, one in each dynamo room, are not yet installed. They will be of a simple type. The temporary switchboard for two dynamos is of white marble and contains three single-pole, single-break, knife switches for each dynamo, one in each phase, mounted on high corrugated rubber bases. The exciters are compound wound and are connected through three-point switches. Thomson alternating voltmeters, 0 to 6000, and ammeters, 0 to 200, are in the main circuit, while the lamps used to illuminate the board are used as detectors in synchronizing the dynamos for parallel operation. The exciter circuit is provided with Weston volt and ampere meters. No circuit breakers are used, long fuses of the General Electric type, blowing in a magnetic field, being used in each phase. There is no other protection against lightning in the power house than that provided by these fuses.

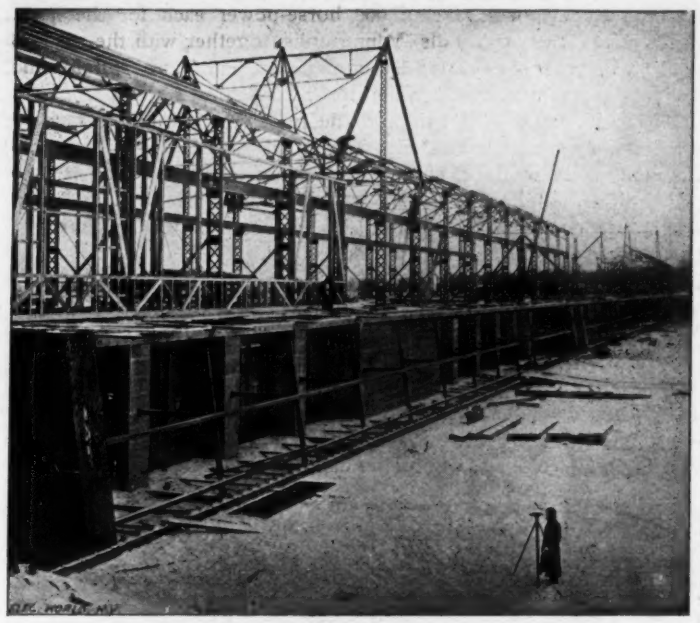
An interesting feature of the power house is the absence of all fire and chimneys. It is heated throughout by electric heaters, manufactured by the Canadian General Electric Company, and it is expected that, even in the climate of Montreal, they will prove sufficient. The flat heaters are arranged against the walls, about 30 inches from the floor. No data of their current consumption have as yet been given out.

The circuits leave the building through appropriate ducts in the walls, and are connected just outside of the building to the bare wires of the pole line. These are dead-ended against the end walls of the building through about a dozen globe-pattern street-railway strain insulators.

The aerial line to the first sub-station is 30,000 feet long, the circuits being composed of O bare copper wire. This is sustained by porcelain insulators of the Niagara type, made by the Imperial Porcelain Works, of Trenton, N. J., mounted on locust pins. The circuits are run in triangles of 18 inches on each side. The poles are of iron, of a lattice construction, and are set 104 feet apart and 7 feet deep in concrete. Each is tested before use under a lateral strain of 6200 pounds, so that it may withstand the wind pressures of the severe winter storms of the Canadian climate. The line is pro-

tected at frequent intervals by Wirt lightning arresters of the Niagara pattern. The full load drop from dynamos to transformer secondaries will be 10 per cent.

In the city of Montreal the company has three power sub-stations. In the plant of the Citizens Electric Light Company, owned by the Lachine Company, three static transformers, of 150 kilowatts each,



THE CROSS DAM AND POWER-HOUSE FRAMING.

reduce the line current to 2000 or 1000 volts, three-phase and two-phase. These transformers, like all the others employed by this company, were built by the Wagner Electric Manufacturing Company, of St. Louis. They are oil insulated and are cooled by water jackets. Every transformer is tested for one hour at 25,000 volts before being installed. From this sub-station there are already operated 20,000 incandescent lamps.

In another sub-station static transformers and a rotary converter of 200 kilowatts, built by the Walker Company, Cleveland, Ohio, will be installed to supply direct current at 250 volts to a district largely filled with motors adapted for this current.

A FEW OF THE TURBINES.

The arc-lighting sub-station will contain two sets, each consisting of a synchronous motor of the type of the generators, being 200-kw capacity, direct coupled to two 125 light arc dynamos. The company is now operating 350 street arcs by steam, and these will be connected with this sub-station.

In addition to these sub-stations 80 miles of conduits have been laid, including one which carries the main line under the Lachine Canal. In these conduits the three-phase line current at the full pressure will be carried in three-wire cables, of which about 4 miles are already installed. Manholes at convenient intervals will contain static transformers, giving 52 or 104 volts in each phase for incandescent lighting, or such arrangements of phases and pressures as the motors of the immediate district may require. The paper-insulated cables and cement-lined tubes for the conduits were furnished by the National Conduit & Cable Company, of New York. The Lachine Company expects to construct an electric railway to a point near the power house, where it owns a large tract of land, very beautifully situated, in view of the rapids. Contrary to precedent, it is intended to develop this as a residence district, and not as a manufacturing site.

It is the intention of this company to sell current at one-half cent per ampere hour at 52 volts. Motor current is to be furnished at a correspondingly low rate, and a strong effort will be made for

ON THE WING DAM.

the general introduction of electric cooking and heating apparatus in Montreal and its vicinity. It is claimed that this company can profitably compete for heating with anthracite coal at $6 per ton.

Great care was necessary to guard against the dreaded anchor ice, or *frazil*, the bane of water powers in high latitudes. As has been described, the upper end of the raceway at Lachine is guarded by

BUILDING THE WING DAM.

a substantial boom, inclined to the direction of the current, which is intended to deflect floating ice. A system of other booms, in the still water of the basin above the power-house dam and within the wing dam, acts as further safeguards, but the greatest reliance is placed in the small velocity of the water in the intake, which will conduce to the early freezing of the surface. It is held by experts in the matter that *frazil* will not form under surface ice.

A more formidable difficulty, the blocking of the 1200-foot tail race by ice, has been met in the same way. An enormous amount of blasting, removing the hard limestone of the bed of the St. Lawrence, resulted in a mean depth of .6 feet for this tail race, and will so reduce the velocity of the water in it that it is confidently expected to freeze over the surface early in the season, leaving a free passage, clear of anchor ice, below.

On Saturday, September 25, the plant was formally opened, the mayor of Montreal turning on the water. Mrs. G. B. Burland, the wife of the president of the company, closed the switch which turned on the Lachine current at Montreal, amidst much applause from the 2000 or more guests present.

This large enterprise is chiefly due to the efforts of Mr. W. McLea Walbank, the managing director of the company, and chief engineer of the construction. Messrs. T. Pringle & Son, of Montreal, were associated with Mr. Walbank as mechanical engineers. A curious feature of the enterprise, and one worthy of enthusiastic commendation, is that every dollar of the $1,400,000 required was paid in cash subscriptions, and that the whole construction was on a cash basis. The shareholders are nearly all residents of Montreal and Ottawa, and the enterprise is purely Canadian.

Lord Kelvin at Schenectady.

On Saturday, September 25, Lord Kelvin, accompanied by Lady Kelvin and a number of gentlemen interested in engineering and finance, were the guests of the General Electric Company, at Schenectady, N. Y. During Lord Kelvin's stay in this country he has availed himself very fully of the opportunities which were offered to him for seeing the enormous development of the electrical industry since his last visit in 1884. His travels extended as far West as Vancouver, and his tour of inspection of plants was fitly closed by his visit to the largest and most representative electrical construction works in America.

Lord and Lady Kelvin and Group of Visitors at Schenectady.

It has been arranged that when the distinguished party arrived they should be shown through the works in detail, and the most interesting points explained by officers of the company. During the two or three hours occupied by the party in traversing the many shops, none displayed more interest than Lord Kelvin, nor showed greater enthusiasm.

Under the immediate care of Professor Thomson and E. W. Rice, Jr., Lord Kelvin was conducted through the works, starting at building No. 9, where the heavy machinery is constructed. This building was crowded with dynamo parts in all stages of completion. All the machinery in the shop is operated by electric motors, and many are so arranged that the work may be kept stationary while the cutting mechanism is moved from point to point as the operations require. This building contains some very large planers, and the largest boring mill ever built.

From this building the party passed into the testing room, where every machine is subjected to rigid test before shipment. Connected to this building and forming part of it is the machine shop and shipping department, a total length of 1320 feet all under one roof, with electric traveling cranes running from end to end, carrying the unfinished parts to their respective assembling points, and the finished machines finally to the shipping-department. In planning this building everything was disposed for handling the machinery with the utmost rapidity and precision. Ranged down both sides of the central aisle stood machines of all sorts and sizes—from that with a capacity of some fifteen or twenty 16-cp lamps to those built to supply current to the enormous number of 30,000 lamps. One of these latter machines had just been shipped to Brooklyn, the parts making five complete carloads. Seven 1500-hp railway generators were in process of completion for the Fourth and Sixth Avenue lines of the Metropolitan Traction Company, and two of 2000 horse-power each for Boston. Under test were two 1000-hp three phasers for the Lachine Rapids plant, five of 600 horse-power each for the great works at St. Anthony's Falls, Minneapolis, together with the 1250-hp 20,000 volt transformers for use at Niagara Falls and Buffalo, and five 700-hp rotary converters, also for St. Anthony's Falls.

Lifting its respectable height to the roof was one of the 1200-hp. smooth-body armature machines for the Edison Electric Illuminating Company of New York, almost ready for shipment.

From this building the party passed into the power house, in which was shown an interesting collection of dynamos, including many of the older types of machines, as well as some of the most recent, all in operation, furnishing power to each department through a system of underground conductors. The next building visited was No. 15, in which the greater part of the armature winding and the manufacture of armature coils is carried on. Here Lord Kelvin was shown examples of the recently developed G. E. revolving-field alternators, dynamos with revolving fields and stationary armatures —a method of construction adapted to allow of more perfect insulation for high voltages, while eliminating collector rings and moving contacts. In long-distance transmission work such dynamos as these can be wound for the high voltages necessary for the transmission lines and step-up transformers be dispensed with. Wound for a pressure up to 15,000 volts, they are subjected to very high voltage tests, the 1000-kw three-phase alternator for the Brooklyn Edison Company being tested in the presence of Lord Kelvin, under a pressure of 25,000 volts. He was too lots to see the 2000-kw machine for the same company, which left the works on the day previous. The diameter of this machine is 25 feet. It weighs 163,000 pounds, and is, perhaps, the largest dynamo ever built in point of size. Its speed is 75 revolutions, the field being keyed directly to the engine shaft.

An interesting experiment in high-voltage currents was then made by Mr. C. P. Steinmetz. An arc was sprung between two metallic points, some 15 inches apart, with the current at a pressure of 180,000 to 200,000 volts, and drawn out at a length of about 5 feet, until it could no longer hold.

Passing from building 15 to building 12 the principle of Professor Thomson's magnetic blow-out was exhibited. A current of 1000 amperes at 500 volts was passed through an automatic circuit breaker, and the extinction of the arc instantaneously was fully demonstrated. To show the effect of the magnetic blow-out on a blown fuse, the magnetic fuse box was brought into requisition, and the same test applied. The blown fuse withdrawn showed the very small amount of metal melted, as the arc was created and extinguished. The railway-motor testing department was next visited, and the method of testing railway motors under very severe conditions explained.

The party then proceeded to the rear of building 23, where the new surface-contact system of the General Electric Company was shown in actual operation, with all the working details visible. The advantages of such a system for city streets were quickly appreciated. The overhead trolley wire is superseded by a series of small cast-iron discs set in the pavement in parallel rows between the rails of the track, each disc convexed to about 1 inch above the surface, at distances of about 4 feet. The disc near to one rail is the positive disc, that near the other the negative disc. In this system only those disc immediately under the car are alive; all the others are without current. The current is brought to the positive discs by an automatic magnetic switch, which is set with a number of others in a manhole, instead of being buried in the street near to its own disc. The car is provided with a small storage battery, and with two long shoes suspended beneath it, touching always one or two discs. To start the car current from the battery is let into the shoe. This energizes through the disc the coil in the automatic switch, and establishes connection between the feeder circuit and the motors. All leakage is taken care of by placing the negative discs in a cast-iron box, which acts as a shield, and effectually takes care of any wandering current. Sparking in the automatic switches is prevented by providing them with magnetic blow-outs.

After witnessing the operation of this system, the party mounted the searchlight tower, whence a splendid bird's-eye view of the entire works was had. Descending this the party was grouped at the base and photographed.

The electric brake for electric cars, then shown to Lord Kelvin on car No. 9 of the Schenectady Street Railway, practically gives the motorman an automatic and instantaneous check on the motion of the car, the brake being applied by the same single movement of the handle of his controller which cuts out the current from the motors.

The brake consists of two steel discs, one of which contains a coil of wire, the other is a plain metal disc. The moment the car is stopped and no current is flowing from the controller the motors become very powerful dynamos, which turn their current into the coil of that one of the discs which is attached to the motor. It then becomes a very powerful electromagnet, with a strong power of attraction. The other disc is revolving on its axle, but the moment the first disc becomes an electromagnet its attraction is so powerful to the surface of the latter that it is brought to a standstill, and with it, the car.

Should the wheels skid, as on an incline, the armatures of the motors naturally stop; the discs separate, the wheels begin to revolve again, and the moment they do so current is generated in the motors, and the disc with the coil becomes an electromagnet, and the car stops again. In other words, the brake is always in operation once it is applied.

Asked to express an opinion on his visit, Lord Kelvin said: "I am enjoying myself very much and learning enormously. There are no shops in the world like these; they are among the great wonders of America."

Convention of the National Street Lighting Association.

The second annual meeting of the National Street Lighting Association was held at Columbus, Ohio, from September 28 to October 1. Simultaneously with this convention at the same city was held the Convention of Mayors and Councilmen of the United States, Canada and Mexico. The two conventions had one joint session. The latter convention was called to order by Mayor Black, of Columbus, on September 28, with 150 accredited delegates present. Governor Bushnell delivered the address of welcome, and Mayor C. A. Collier, of Atlanta, Ga., responded for the visitors. Mayor Black was made chairman of the convention. Mayor John McVicker, of Des Moines, Ia., read before the convention a strong paper, urging the ownership, or at least the control, by the cities of all franchises. This opened a general discussion of the question of municipal privileges, which brought out the fact that the convention is strongly in favor of ownership by the cities of all or most of the quasi-public franchises.

Mr. F. B. Doran, mayor of St. Paul, said, in the course of this discussion: "If we could be sure that under city control the street cars, gas and water works would be conducted on purely business principles, I would heartily sanction municipal ownership of them all; but I am not sure of that. In fact, I have seen employees of the city and those of private companies working side by side in the streets often, and noted that the employees of the company always accomplished much more than those of the city do. It is because the company is careful to secure efficient laborers, while the city is 'taking care of the voters.'

"That does not mean, however, that the city should sell franchises or give them away, as is done every day. I am in favor of municipal control, rather than operation of these franchises."

Gold in Large Quantities.

Some time ago considerable interest was taken in the suggestion to extract the large amount of gold known to be contained in the sea water, in which the electric process would probably be the only one available. There is, however, a large amount of gold even nearer at hand. Mr. A. E. Outerbridge, an authority whose statements will probably not be questioned, states in a recent article in the *Popular Science Monthly* that assays made by the Mint show that the clay in Philadelphia contains 3 cents worth of gold to the cubic foot; every load of clay that is excavated for building purposes therefore contains enough gold to pay for the carting. There is more gold under the city of Philadelphia than has yet been brought from California and Australia. Every brick made from this clay contains enough gold to form two square inches of gold leaf. All that is wanting therefore is a cheap enough process to extract it, and it is not unlikely that if such a process is ever found it will be an electrical one.

Improving "Slow" Cars.

Nearly every electric road has one or more cars that are slow. They may be of a comparatively primitive type, as far as the motors are concerned, but the trouble can usually be cured by rewinding the armatures and fields, or by a rearrangement of the controlling apparatus. The presence of a single slow car will make itself felt very quickly over the whole line upon which it runs; and the quicker such a car is sent to the shop and "speeded up," the better will it be for the interests of the company operating it. On one road it has been the custom to run such cars only when the traffic was heaviest, probably with the idea that as the cars could not travel fast at such times, the slow car would not cause much trouble. The reverse of this was found to be the case. The slow car was slow in getting up to speed after stops, and caused great delay by that action. These cars are now operated only at night, when the motormen are naturally inclined to wild running. The slowness of the car acts as a check in this direction. Thus some use is made of the slow cars, but in spite of this they are being put into the shop to have motors rewound as fast as possible.

Submarine Cable from Scotland to Iceland.

A London dispatch, dated September 26, states that the Icelandic Parliament has voted a subsidy for the laying of a cable from Scotland to Iceland by way of the Faroe Islands. The Great Northern Telegraph Company will lay the cable during the early summer next year. It is said that Great Britain will make cable connection from Iceland to British America.

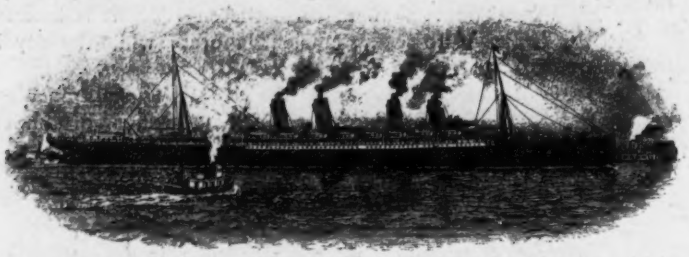
Electric Railway to Heaven.

England being a very pious country, the electric railway at Brighton does not run on Sundays, and the station is therefore used by psalm singers, and decorated with banners carrying inscriptions. A correspondent to the London *Electrical Review* states that on one occasion he read the following combination: "Seek ye the Lord where he may be found.—Electric cars every five minutes."

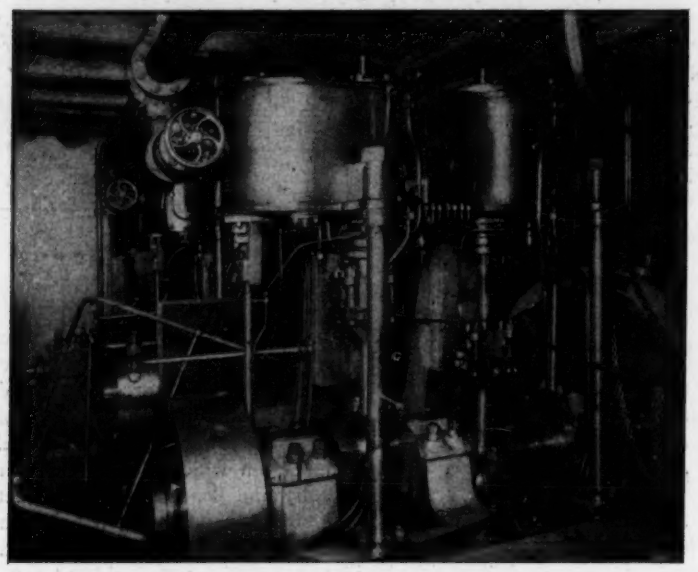
Hello!

When telephones are stripped of wires,
And we can talk through vapor,
Will it be hard to voice desires
And cut the vocal caper?
And will we sound the loud "Hello!"
And grow half-blind and dizzy,
Until a shrill voice lets us know
The blasted line is busy?

The Lighting of the Steamship Kaiser Wilhelm der Grosse.



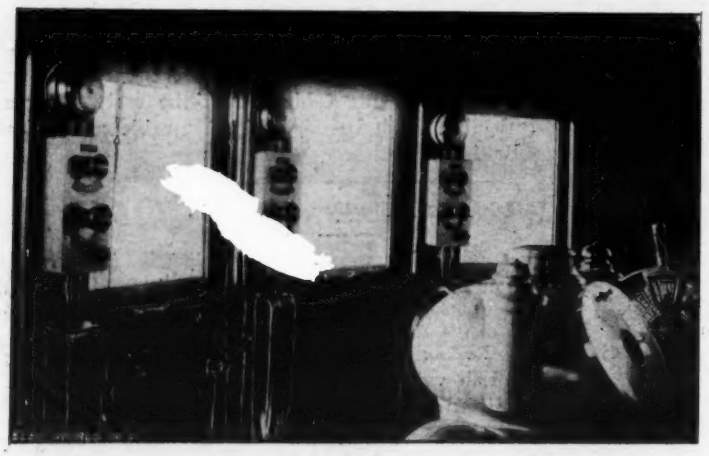
A new ship has been added to the extensive fleet of the North German Lloyd steamship line. This ship will ply in the fast-express service between New York, Southampton and Bremen. She made her first appearance in New York harbor on Monday, September 27, having lowered all previous records from Southampton on her



Lighting Engine and Dynamo.

first trip. She is at present the largest craft afloat, her length over all being 648 feet, and beam 66 feet. Her displacement is 20,000 tons.

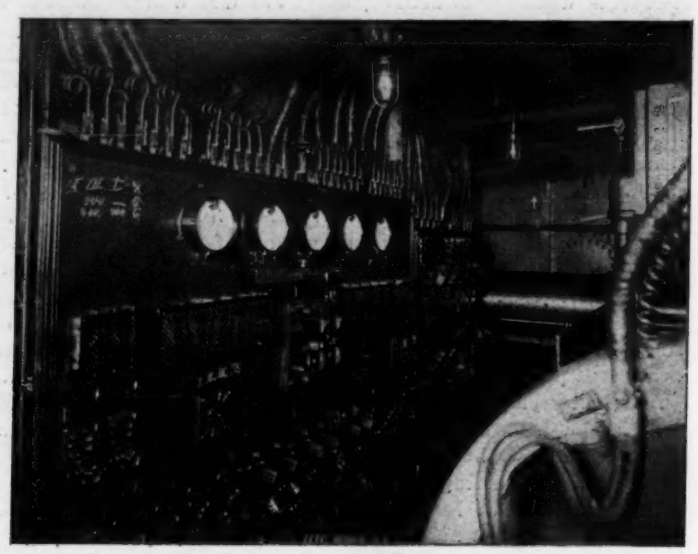
The ship and main engines were built by the Vulcan Ship Building Company, of Stettin. She is fitted with two triple-expansion, four-crank, four-cylinder engines, having an aggregate horse-power of approximately 30,000. The cylinder diameters are 52, 89¾, and two 96½ inches. The propellers are three-bladed and over 22 feet



Loud-Speaking Telephones in Bridge Shelter.

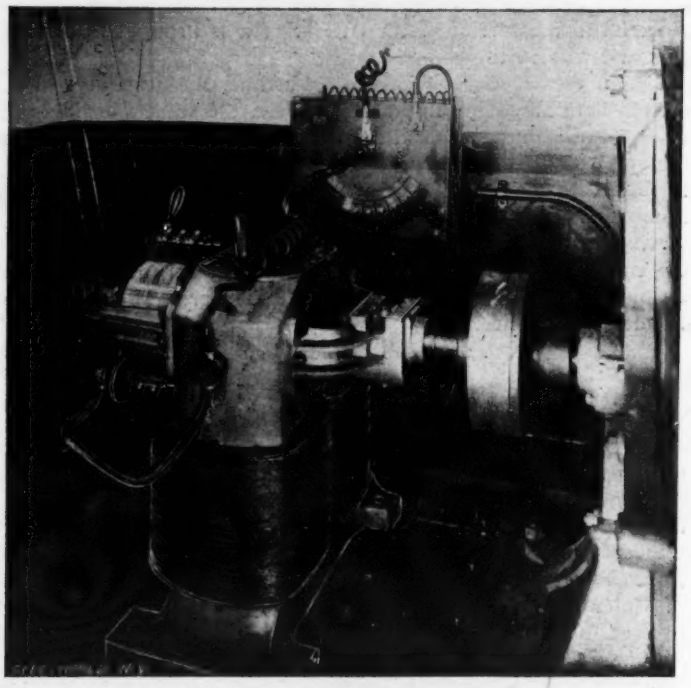
in diameter. The ship presents a remarkable appearance in that she is fitted with four smoke stacks, a feature never before found in mercantile service.

Her lighting equipment was supplied complete by the Allgemeine Elektricitats Gesellschaft. The generators consist of four direct-connected units of 110 horse-power each. These units are capable of giving an aggregate of 2800 amperes at 110 volts. Three of the engines are located, with an ammonia refrigerating plant, in a small separate engine room in the bottom of the ship between the two main shafts and immediately aft of the thrust blocks. One of the enormous 24-inch nickel-steel shafts may be seen in one of the illustrations. The lighting units are placed with their shafts across-ships. The engines are of the vertical cross-compound, open-front



Main Switchboard, Twenty-four-Inch Main Shaft in Background.

marine type, with single valves. The speed is controlled by a shaft governor operating the eccentric of the high-pressure valve. The dimensions of the cylinders of these engines are 280 and 470x500 millimeters (11 and 19x20 inches). They run at a speed of 300 turns per minute. The cranks of the engines are set at 180° to minimize the vibration. Considering this fact the engines are noticeable for the lack of fly-wheel weight, the maximum moment of inertia being

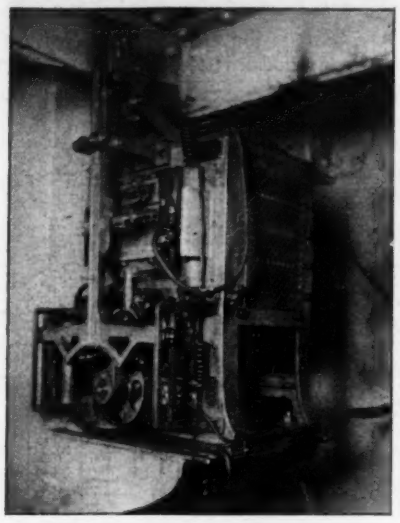


Motor Driving Steerage Ventilator.

that of the armature itself. This is probably due to the desire to avoid gyroscopic strains in a rolling sea. The dynamos are eight-pole, shunt-wound machines of the external-field ring and internal-projecting pole type. The fields and field rings are of forged iron, one-half the field ring and the four cores attached thereto being forged in one piece.

One of the generating units is placed between decks high above the water line in a little compartment opening into the port engine room. This is probably done to give service in case of any acci-

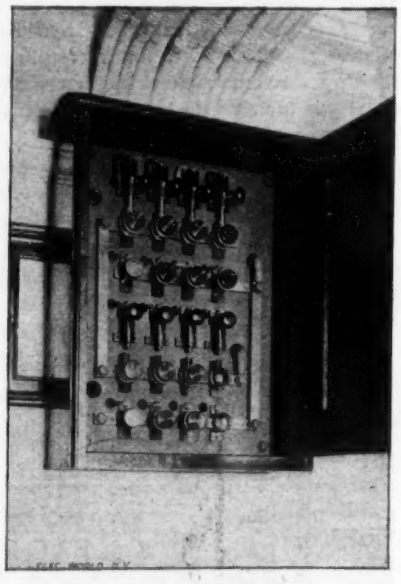
dental flooding of the lower room. The four generating units, however, are all worked in parallel from the one main switchboard. This switchboard is fitted with quick-break switches, and is arranged with two sets of bus bars, one for the lighting load and one for the motor load, with a main switch for throwing the two in multiple. There are on board the ship some 1800 lamps of 25 candle-power each. These lamps are supplied by concentric conductors in brass-armored conduit, with the exception of the engine-room lines, which are iron-armored. About 15 miles of conduit were used in wiring.



MAIL HOIST CONTROLLER.

Besides this lighting load there are in use altogether some twenty-eight motors. Sixteen of these are of 5 horse-power each, and are used to drive forced-draught blowers for the fire rooms. Ten motors are used for centrifugal blowers for ventilating purposes. One of these, which is used in ventilating the steerage, is shown in an illustration. Two motors are used for hoists. One of these raises and lowers the mail sacks to and from the hold in which they are transported, and the other raises provisions from the store rooms to the kitchens. The controllers of these hoists differ widely from anything ever seen in this country. The rheostat brushes move vertically over resistance contacts, and are controlled by an escapement and an oscillating beam. By means of slide weights on this beam the acceleration can be made as fast or slow as desired.

One of the distribution panel boxes is shown in an illustration. This panel box is double-pole and contains fuse plugs of the regular Edison type, the metal contacts of which press down on a common bus bar. The switches are made up like regular old-fashioned door bolts. When pushed down the handle is turned to the right, as shown in the upper row of switches, which locks the switch closed. When the handle is again swung to the middle position, the spring around the bolt throws it up, thus giving a quick break on opening. As may be seen from the illustration, there are no cross-overs or raised work in the panel box whatever.



PANEL DISTRIBUTION BOX.

Provision is made for communicating from the bridge of this ship to the two engine rooms, and also to the after-bridge by means of three telephones, made by the Siemen & Halske Electric Company. The instruments on the forward bridge are located, as may be seen in one of the illustrations, in a shelter which is built in the centre of the bridge immediately forward of the pilot-house. The instruments look very odd to American eyes, being made of German silver, and having no flexibly connected receiver. The signal bell is mounted above the instrument, and contains within itself its electro-magnetic-ringing mechanism. The microphone transmitter and magnetic receiver are rigidly mounted in the German silver case. The chief innovation in these telephones is the use of the dynamo currents from the main lighting circuit in the place of batteries. About 6 amperes of current are required when the instrument is in use, which current passes over the whole circuit, there being no induction coils in the apparatus. These telephones are extremely powerful, the voice being reproduced with sufficient power to be audible 30 feet away when there are no disturbing noises.

An Interesting Battery.

A story is going the rounds of the daily press to the effect that a Boston telephone electrician has made the smallest galvanic battery ever constructed. As the details of construction are given in a very vague manner, it is difficult to determine whether the claim is justly founded. The battery certainly does not possess the historical interest that belongs to the unique and diminutive cell illustrated and described below.

After the Atlantic cable was successfully laid in the '60s, one of the problems for practical solution was that relating to the proper amount of battery to operate the cable. At that time there was no experience to guide the workers in the new and unexplored field, consequently knowledge on this important subject had to be acquired by new experience. The first working Atlantic cable was operated by a current from a battery of ten capacious cells, constructed on the Smee principle. Experiments were afterward conducted to determine the minimum quantity of current that would operate the

THE GUN-CAP BATTERY—ABOUT ACTUAL SIZE.

receiving instruments at the opposite end of the cable, and in 1866 a cell was fashioned out of a lady's silver thimble. The records show that the signals transmitted by the use of this cell vigorously influenced the receiving instrument. The acidulated water in the thimble was diluted in stages until there seemed to be hardly any trace of the acid left—no more than a highly diluted homeopathic dose—but still the cable worked.

A later experiment was with a battery constructed out of a gun-cap. A piece of No. 16 bare copper wire was procured, one end of which was firmly looped around the head of an empty gun-cap. To one end of another similar length of wire was bound, with fine copper wire, a short strip of zinc bent at a right angle, the free end constituting the negative electrode of the diminutive cell. After charging the cell with a drop of acidulated water, and properly connecting the terminals with earth and cable, signals were successfully transmitted over the cable by the infinitesimal current generated by this tiny couple. The receiving operator reported that the signals were "awfully small," but they were intelligible, and messages were transmitted from Heart's Content to Valentia.

It should be stated in explanation that the silver-thimble battery was used at the Valentia end of the cable. But, not to be outdone, the American operator conceived the gun-cap battery idea. Mr. William Dickerson, electrician for the Anglo-American Telegraph Company, was the gentleman at Heart's Content who constructed the gun-cap battery. This interesting relic was several years afterward presented to Mr. H. H. Ward, cashier of the Western Union Telegraph Company, in New York City, who kindly loaned it to us for the purpose of illustration.

Accommodating Water Falls.

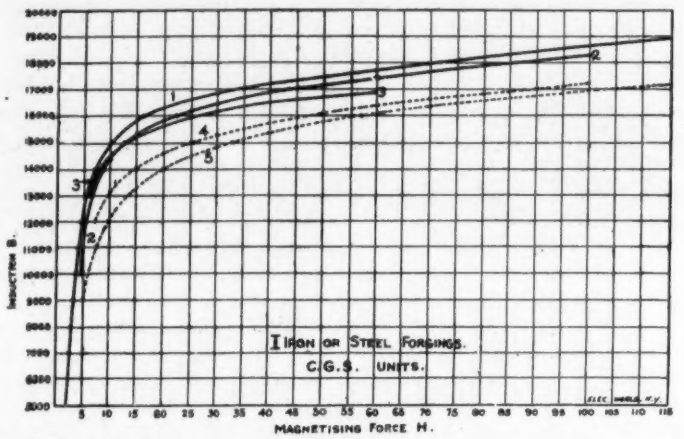
The waterfalls in Switzerland are especially well adapted for generating power for the benefit of tourists, that is, for mountain railways and similar installations. In the summer when the tourist traffic is greatest the amount of water in the streams is greatest, as the sun is melting the snow on the mountains; in the winter, when there is practically no tourist traffic, the flow of water is least.

Success of Electric Cabs.

That the electric cabs recently started in London are a success is shown by the fact that the executive committee of the London Cab Trade Council passed a resolution that "this council meeting views with disapproval the introduction of electric cabs on the streets of London, and urges all cab drivers in the interest of the cab industry to discourage any further development of public vehicles driven by motive (sic) power."

Magnetic Materials for Dynamos.*

During recent years numerous accurate tests of the iron or steel used in the manufacture of dynamos and transformers have made their magnetic qualities much more precisely known to us than formerly, and this increased knowledge has in turn led to great improvement in the materials themselves. Hence it is worth while for the designer, from time to time, to review the various magnetic materials in every-day use, in order to compare their relative values and see what may fairly be expected of each class. Not many years ago, if asked for a permeability curve of his forgings or castings, the iron-master would have been at a loss to know what was meant; almost the only data then available for the electrician were the curves published by Dr. J. Hopkinson, in 1885, for annealed wrought iron and gray cast iron. The iron and steel manufacturers were not, however, slow to see the commercial importance of a curve, and since then a number of such curves have been accurately determined. The results have in many cases been published in various papers, but the plotting of these and others to form three groups of curves should be of value as illustrating the present position of the chief magnetic materials in the three great classes of forgings, steel castings and armature stampings. With the exception of two curves taken by the Electrical Standardizing, Testing and Training Institution, all of the tests have been carried out by Professor Ewing, and in every case the material is not simply a laboratory product, but is being supplied to-day commercially for manufacturing purposes. For permission to publish the curves we are indebted to the courtesy of the following firms and gentlemen: Messrs. Edgar Allen & Co., Campbell Macmaster & Co., Thomas Firth & Sons, Alfred Hickman, Mr. R. Jenkins, Charles Jennings & Co., Fried.



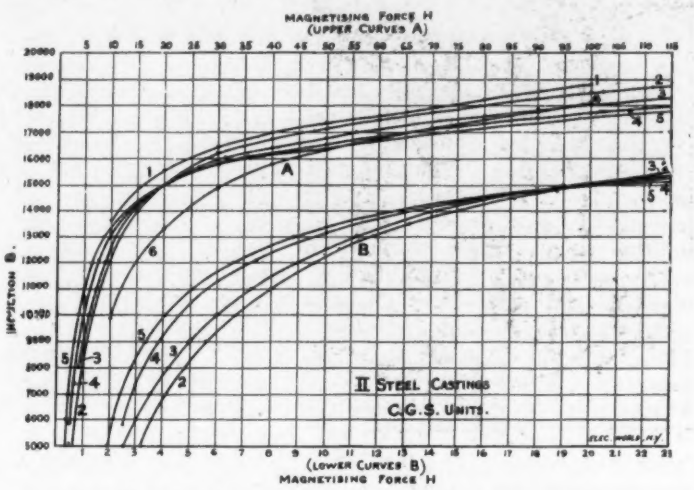
Krupp, of Essen; Samuel Osborne & Co., John Rogerson & Co., Joseph Sankey & Sons, and Mr. Ernst B. Westman.

I.—Iron or Steel Forgings.

As a material for dynamo magnets the forged ingot iron, of which the curve (1 I.) appears at the head of our first set, gives, on the whole, the highest results. It may in general be said that while the best wrought iron, such as annealed Lowmoor or Swedish, is more permeable than steel castings at low inductions, the cast steel surpasses the wrought metal for high inductions. The material of curve 1 is, however, the most permeable nearly throughout the whole scale; at low inductions it is slightly superior to the wrought iron, and it only becomes inferior to the highest cast steel when the induction is pressed beyond $\mathfrak{B} = 18{,}000$ C. G. S. lines per square centimeter. The curve is almost coincident with that of an exceptionally pure specimen of iron, which was prepared for experimental purposes, and for which the figures are given in the *Proceedings* of the Royal Society for June 16, 1892.

For inductions above 13,000 the three materials to which the full line curves 1, 2, 3 of Group I. apply are all considerably superior to the best annealed wrought iron, and hence they have largely displaced the wrought iron, which was long the favorite material for dynamo magnets. All the three are forged, but unlike wrought iron, which consists of a number of puddled balls or scrap iron pieces welded together, they are homogeneous from having been once thoroughly fused. Owing to their method of production they may technically be ranked as soft steels with a small percentage of carbon, but a better description of them is conveyed by the German term "flusseisen," or its nearest British equivalent, "ingot iron." The chemical substance of the first three materials of Group I. and of those of Group III. is in fact practically the same, viz., nearly pure iron; in the one group it is forged into magnet shape under hammer or press, or is rolled into bars, and in the other group it is simply cast. The forgings are on the whole more permeable from $\mathfrak{B} = 13{,}000$ to $\mathfrak{B} = 16{,}500$, while the castings are on the whole preferable for still higher inductions. Thus a chemical analysis of the material of Curve 1 I. would probably show that it was to all intents pure iron, and that its high permeability was due to its low percentage of carbons and freedom from all impurities, such as manganese, phosphorus and silicon.

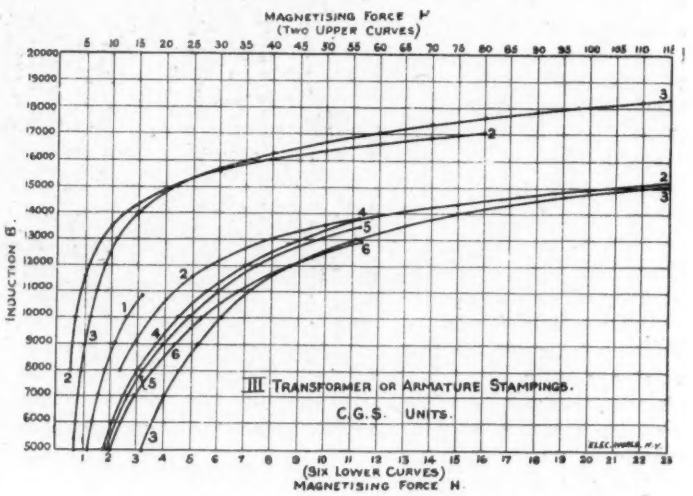
Up to $\mathfrak{B} = 16{,}500$ the difference between the full-line curves of the three forged materials is not very great, and this figure may be taken



as a suitable limit to the induction at which it is economical to work them in dynamos. For the purpose of comparison, the two dotted curves 4 and 5 for annealed wrought iron are added, the lower of the two being the 1885 curve of Dr. Hopkinson, from which the progress made in 1897 will be evident.

II.—Steel Castings.

The six upper curves of Group II. are divisible into the set numbered from 2 to 5 inclusive, and the remaining 1 and 6, which are respectively the highest and lowest for low inductions. The peculiarity of the former set is that they all cross at $\mathfrak{B}$ 15,000, but their order, which is 2, 3, 4, 5, initially becomes 5, 4, 3, 2, or exactly reversed at higher inductions. In order to show more clearly their relative positions, their figures for low inductions are plotted below the upper A curves to a larger scale of abscissæ (curves B). Material 5 is for cast steel, remarkably permeable at low inductions, but



falls off at higher values. Material 6 illustrates still more forcibly the fact that in steel castings a low initial permeability does not necessarily imply any inferiority at high inductions. For dynamo magnets an induction below 14,000 is seldom employed, and, having regard to the difference of the curves, it is not advisable to press the induction above the same limit as for forgings, viz., $= 16{,}500$, but if a higher induction is required it is more likely to be cheaply obtained with a steel casting than with a forging. The comparative positions of the two Groups I. and II. may be followed by bearing in mind that the highest steel casting curve falls somewhat below the highest forging curve, until an induction of 18,000 is reached; above

*The London *Electrician*, September 17, 1897.

this the casting is slightly superior, and thus holds the record for the greatest permeability at very high inductions.

Magnetically speaking, therefore, forgings and steel castings stand much on the same level, as indeed we should expect from their similarity in chemical composition, and the advantage of the latter is on the score of their easy adaptability to the more complex shapes of multipolar dynamos or motor magnets. There remains the further question of the amount of confidence with which we can rely on the results of the curves being uniformly repeated. In this respect steel castings have very greatly improved, *c. g.*, Curve 2 represents very closely the results of tests on five different samples, some made in 1894 and some in 1896. The chief difficulty now lies in securing good magnetic steel if the shape of the castings requires comparatively thin sheets of metal, say, one-half inch in thickness.

III.—ARMATURE STAMPINGS.

The stampings for armature discs are not very far different in permeability from the former groups, their material being again very similar in chemical analysis. Owing, however, to their repeated mechanical treatment in the rolling mill, their permeability at low inductions is rather higher, although at high inductions they are inferior to the same iron or steel when tested in bulk. As the higher initial permeability does not extend much above $\mathfrak{B} = 6000$, its practical value in dynamo construction is small, although it is of great importance in transformers. In Group III. the two upper curves (2 and 3) are typical examples of armature discs at high inductions, while below the same curves are again plotted, together with four others, to a larger scale of abscissæ. The material of Curve 2 is Swedish iron, as also is that of Curve 4. It will be seen that material 2, while more permeable for inductions up to 15,000, is inferior to material 3 above that limit. For values of $\mathfrak{B} = 15{,}000$ to 17,000, between which limits armatures are usually worked, there is little to chose between any of the samples 2 to 6. For the purpose of comparison Curve 1 is added; the material of this is a special Swedish iron, having an exceptionally high permeability for low inductions, and therefore peculiarly suitable for transformers.

The Telephone System in Buenos Aires.

The annual report of the directors' commission of La Sociedad Co-operativa Telefonica gives an interesting account of its extensive telephone system. This system comprises some 2500 subscribers' lines and 145 trunk lines. Of this the greater part is overhead service, but a large number of conductors are now being put underground. The subterranean system is made up of thirty telephone subways, the cables being protected by cast-iron pipes. The commission reports that although the underground system is more expensive to install, yet in the long run it proves more economical when the improved quality of the service is taken into consideration. In the subways are laid some 642 kilometers of conductors; 517 kilometers are installed in aerial cables. Some 3000 kilometers of overhead wires are also in use. The system is growing rapidly, the number of subscribers having increased 5 per cent. during the year, and the length of the lines having increased 15 per cent. The company employs 174 people, of whom forty-five are women. The average salary paid per month is $61.50, national currency.

A Future Possibility.

The Chicago *Tribune* of September 19 contains an interesting illustration, which, however, is based largely on the imaginative powers of a reporter. It represents some passengers boarding an electric train at Chicago at 6 A. M. and the same persons dining in New York at 6 P. M. the same day. A picture of an electric train is shown traveling over an elevated structure at a high rate of speed; so fast, indeed, that the cars look like spectres in a fog. A story has been going the rounds in the daily press recently to the effect that Chicago men propose to utilize the Tesla system of power transmission for the operation of an electric railway between Chicago and New York, the trains of which are to be run on a 100-mile-an-hour schedule.

Lord Kelvin in Halifax.

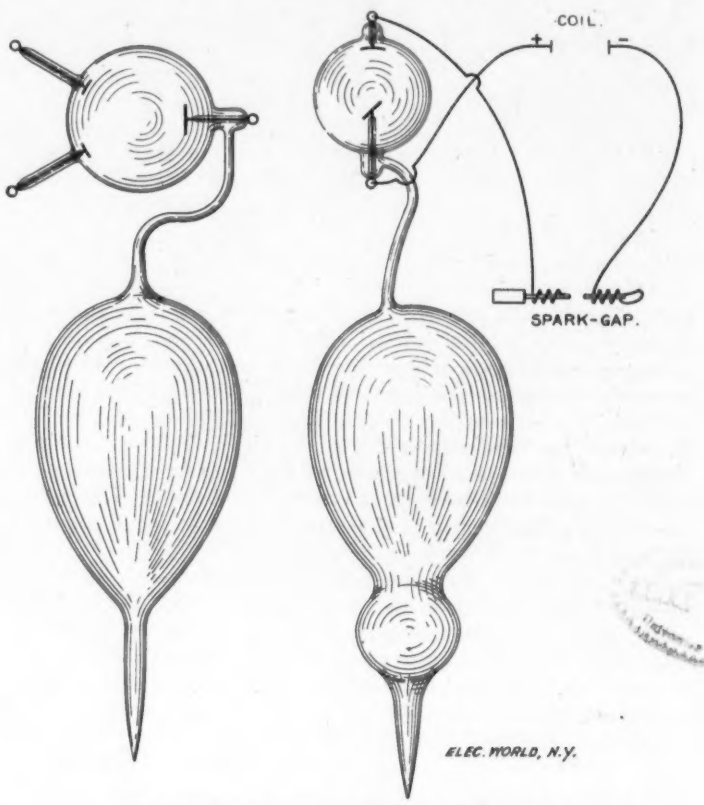
Lord and Lady Kelvin arrived at Halifax on September 27. On the following day, September 28, they took part in the opening of the Nova Scotia exhibition, at which Governor-General Aberdeen was present.

Some Experiments with Crookes Tubes.

BY ALFRED G. DELL.

In making the following experiments I used a Crookes tube, which I had made about a year ago. It is an ordinary 3-inch spherical focus tube, with the aluminum cathode in the top and the platinum anode near the centre. The 3-inch bulb is connected directly under the anode by a long hollow stem to another bulb 5 inches in diameter at its larger part, and about 13 inches in length.

The smaller bulb is covered with wax and shellac, excepting a round space of 2 inches in diameter in front for the exit of the rays. Since receiving the tube I have used it considerably by connecting it to the outside of the condenser of a Wimshurst machine, and passing sparks between the poles of the machine, and have also used it connected to the poles of the machine in the usual way. When connected to the outside of the condenser it will give X-rays with the



CROOKES TUBES WITH ATTACHED BULBS.

smallest spark between the poles of the machine, increasing in strength as the poles are separated. The vacuum has remained permanent up to this time, there being no perceptible change in the strength of the rays sent out, or the greatest length of the spark that can be used between the poles of the machine.

The following are the phenomena seen in the tube when connected to the outside of the condenser of the influence machine:

Between the sparks at the poles there generally appears in the tube directly back of the anode a ring of fluorescent light on the glass, varying in diameter. This is caused by the inrush (charging) from the plates of the machine into the condenser, causing the impulses sent out from the outside coatings to be of the same sign as the inside, the platinum disc becoming the cathode. When the spark occurs between the poles of the machine, there being an outrush (discharge) from the condenser, there appears bright fluorescence directly under the anode and an image of the anode, with its disc reversed in direction, perched in space directly over the anode. There also appears in the larger bulb a streak of light running from the entrance to the bottom of the tube.

The changes, due to the inrush and outrush of the electrical impulses of the machine, can be readily studied by connecting a Geissler tube to the outside coatings of the condenser and passing sparks between the poles of the machine.

When the tube is connected to a coil, whose maximum sparking distance is 4 inches, with the interrupter run by a Sayen break, having an adjustable weight to regulate its frequency, the tube gives but feeble, if any, X-rays; another tube of a higher vacuum, with similar glass construction, but somewhat differently arranged electrodes,

lights up a fluoroscope brightly, the light being visible at a distance of 16 feet from the tube.

In my efforts to make the former-mentioned tube give X-rays, when using a coil instead of a static machine, I constructed a spark gap of gold pointed wires, arranged so I could adjust the gap while the impulses were passing, and noted the different results, which I will describe.

When the spark gap was between the coil and the cathode side of the tube, and closed, I obtained no perceptible X-rays. When I pulled the spark gap out, and began to light up, the light starting with the smallest spark between the points, and increasing as the spark length increased until the fluoroscope was brightly lighted up. The light increased until the point was reached at which the noisy sparks failed to pass between the points, being replaced by a silent discharge.

I will now describe what appeared inside the tube as the spark gap was opened. When closed there was a bright fluorescence directly under the anode, a dim image of the anode disc and stem above the anode disc, and a cloud of peculiarly colored light around the anode. As the spark gap was opened, the fluorescence under the anode remained, the cloud of light around the anode gradually disappeared, and the image of the anode brightened and became more perfect in outline. When the spark gap was opened to such an extent that sparks failed to pass, and the silent discharge between the points took place, there appeared the fluorescent ring back of the anode disc, in appearance as noted above when the influence machine was used, and as seen when the tube is run backwards. It would seem to indicate a reversal of the sign of the impulses from the coil, the anode becoming the cathode. I tried the other tube, that is, the one that worked well with the coil, and found that the spark gap was of no benefit, as there seemed to be no room for improvement as regards the light and definition obtained. I also tried the spark gap between the anode and the coil, but could perceive no difference when thus connected from the other. I think it likely that many tubes are cast to one side as worthless which would work well if arranged with a spark gap as described above; if, however, a tube works well, the spark-gap arrangement is no improvement, but an injury.

Each one of the tubes has a strip of tinfoil pasted on the glass directly behind the anode disc, and connected to the leading in wire. It benefited the tube that works well without a spark gap in the circuit, but the tube that requires the spark gap for the production of X-rays received no benefit, it appearing to be entirely without effect, one way or the other. The tinfoil strips are covered with the wax and shellac, which cover the bulbs.

Relative Value of 220-Volt and 110-Volt Lamps.

BY FRANCIS W. WILLCOX.

The subject of 220-volt lamps has been given considerable attention in the past year. Although many articles and discussions on the subject have appeared in the electrical papers of late, there seems to have been no attention paid to the practical question determining when it is economy to adopt 220 volt in place of 110 volt, and when not.

Mr. John Howell has written on some special features of 220-volt lamps and their production. A very interesting account of the practical operation of a 220-volt system, by A. H. Perkins, was given in THE ELECTRICAL WORLD of July 10. More recently Professor Shepardson has read a paper before the N. W. Elec. Association on the subject, giving results of some tests made by him. In the June number of the *American Electrician* an English engineer gives an account of the practical operation of 220-volt lamps in England, in which he pays a flattering tribute to the 220-volt lamp as follows:

"Without going into the entire history of the development of the 220-volt lamp, I may say at once that many manufacturers are now making them quite as efficient and satisfactory as those for 110 volts. Indeed, it would be difficult to detect by mere inspection in what the difference consists. They are made in a similar size of bulb, have similar terminals, may be obtained for all range of candle power, and are equal in life and reliability. If there is any perceptible difference it is in the form of the filament."

This statement, while not an incorrect one as applied to English makes of lamps, since low economy 4-watt lamps are the ones generally used abroad at all voltages, is very misleading in the impression it conveys. The extract serves to show the imperfect knowledge, even among engineers, of what constitutes the real merits of an incandescent lamp, and what is the relative standing of 220-volt lamps and 110-volt lamps. Because such lamps "have similar sizes of bulbs and similar terminals" and are equal in life, it by no means follows that 220-volt lamps are the equal of 110-volt lamps.

All these articles and descriptions of 220-volt lamps have unqualifiedly praised the 220-volt system, and have shown the influence of the reasoning that because a saving in copper is effected, and since 220-volt lamps are successfully operated, that, therefore, the 220-volt system must of necessity be better than either a 110-volt, two or three-wire system.

There are several other important questions besides those considered in such reasoning, and it is the purpose of this article to point them out and show how they enter into the proper consideration of the question. It is the writer's desire to touch upon the practical engineering phase of the subject, as it concerns economical lighting service, and to determine, as far as possible, a definite answer to the question when does it pay to instal a 220-volt system. The discussion is, of course, made on the basis of what is best from the standpoint of a correctly engineered lighting service, and assumes that there is sufficient capital to adopt and properly instal whatever system is best.

In the first place, it is evident that the one consideration suggesting and recommending the 220-volt system for lighting purposes is the saving in copper it effects over the 110-volt system. This is three-fourths in case of the 110-volt two-wire system, and about one-eighth in case of the 110-volt three-wire system. On the other hand, the objection to the 220-volt system is the lower efficiency of 220-volt lamps as compared with 110-volt lamps of the same stability as to candle power, average useful life, etc. This lower efficiency of 220-volt lamps means that there must be extra capacity of steam and electric machinery, and extra power consumption over what is necessary with a 110-volt system, supplying the same number of lamps. Where do these considerations for and against the 220-volt system balance one another? It is evident that with other things equal such a point determines which system it is best to adopt.

Before actually determining this point, it will be necessary to consider the relative values of 110-volt and 220-volt lamps, as this has an important bearing on the solution of the question.

A 220-volt lamp, as now furnished in the United States (there is nothing made abroad which is equal to it) is of 4 watts per candle efficiency (the English Parliamentary standard candle). In average life, maintenance of candle power and general performance, it stands between the 3.1 watts and 3.6 watts per candle 110-volt lamps. If the value in candle hours of the 110-volt 3.1-watt lamp be represented by 1, then that of the 220-volt 4-watt lamp will be 1½.

The difference in power consumed is nine-tenths watts per candle, the 220-volt lamps requiring and consuming 30 per cent. more power than the 110-volt 3.1-watt lamps. The difference in quality gives the 110-volt 3.1 watt lamps two-thirds value of 220-volt lamps. This means that a station operating a 220-volt system could obtain two-thirds of the average results in lighting as to the life of lamps and maintained candle power with 30 per cent. less capacity of steam and dynamo machinery, and 30 per cent. saving in power were the system changed to a 110-volt system, furnishing the same number of lamps, and operating at the same line loss. This is the substance of the whole situation, and must be understood and kept in mind. It is beside the mark to argue that 110-volt plants use 3.6 watts, and in some cases 4-watt lamps, instead of 3.1-watt lamps, and that, therefore a 220-volt system, with its 4-watt lamp, takes practically no more power. If a 110-volt plant uses 3.6 or 4-watt lamps, then to get the same results on a 220-volt system, 5 or 6-watt lamps should be used. Plants operating at 110 volts will not use 3.1-watt lamps, considering it too fine a lamp for their service, and yet the same company will operate at 220 volts and use the 4-watt lamps without any hesitation, doing practically the very same thing in the latter case that they refrain from doing in the former.

The merit of the question is simply to determine what system is best for any given installation from the standpoint of obtaining equal results in light obtained to power expended. As stated above, the determining considerations are, on the side of the 220-volt system the saving in copper, and on the side of the 110-volt system the saving in capacity of the steam and electric machinery and power required for lighting.

The general law governing the conditions can be stated as follows:

Interest and depreciation on cost of copper saved by 220-volt system over 110-volt system must be equal to or greater than the interest and depreciation on the cost of extra capacity of machinery

and copper, plus the annual cost of extra power required by 220-volt lamps over the corresponding 110-volt lamps. In deducing the equations under this law we will assume 110-volt 3.1-watt lamps and 220-volt 4-watt lamps are equal in quality, and then after reducing to the simple formula we will introduce the factor of two-thirds, which represents the ratio of their qualities as to candle hours given.

As depreciation of copper is very small, it may be considered negligible. The 110 and 220-volt systems considered may be either two-wire or three-wire system. We will consider each case separately. In the following discussion the line loss is assumed to be the same percentage for the 220-volt and 110-volt systems in each case considered. Each system is of sufficient capacity to supply an equal fixed number of lights over the same area.

Let a = cost of copper necessary for 110-volt two-wire system in dollars.

Let a' = cost of copper necessary for 110-volt three-wire system in dollars.

Let a'' = cost of copper necessary for 220-volt two-wire system in dollars.

Let a''' = cost of copper necessary for 220-volt three-wire system in dollars.

then $a' = \frac{3}{8}\, a$ and $a'' = \frac{1}{4}\, a$ and $a''' = 3\text{-}32\, a$.

Let b = cost of steam and electric machinery for 110-volt two-wire system in dollars.

Let b' = same for 110-volt three-wire system in dollars.

Let b'' = same for 220-volt two-wire system in dollars.

Let b''' = same for 220-volt three-wire system in dollars.

If first cost of machinery bore always the same ratio to capacity then $b'' = 1.30b$; since 220-volt lamps require 30 per cent. more power than the corresponding 110-volt lamps. First cost increases at a less ratio than capacity, and b'', therefore $= gb$, in which g is a factor always less than 1.30. Assuming that first cost increases at two-thirds rate of capacity, we would have $g = 1.20$, and $b'' = 1.20\, b$, which will be the assumption in this deduction.

Let d = annual cost in dollars of extra power required by 220-volt lamps over 110-volt lamps.

Let e = interest in per cent.

Let f = depreciation (in per cent.) of steam and electric machinery, depreciation of copper considered negligible.

FIRST:

For the 220-volt two-wire system versus the 110-volt two-wire system.

From the general law noted above under the assumption stated we have the equation—

$e \times 3/4\, a = \text{or} > e \times 1/5\, b + f \times 1/5\, b + e \times 3/10 \times 1/4\, a + d$ or $e \times 15\, a = \text{or} > (e + f)\, 4\, b + e \times 3/2\, a + 20\, d$. Assuming interest at 6 per cent. and depreciation 4 per cent, then $e = 6/100$ and $f = 4/100$ and reducing we have $90\, a = \text{or} > 40\, b + 9\, a + 2000\, d$, or practically $a = \text{or} > 1/2\, b + 25\, d$.

Multiplying the last member of the equation by two-thirds, which represents the ratio of light-giving quality of 110-volt and 220-volt lamps considered, we have $a = > 1/3\, b + 16\ 2/3\, d$, which means that for equal results as to light obtained and same percentage loss in line, the 220-volt system should be used only when cost of copper required by the 110-volt two-wire system is greater than one-third first cost of steam and electric machinery, plus 16 2-3 times annual cost of extra power for 220-volt lamps.

SECOND:

The case of the 220-volt two-wire system versus the 110-volt three-wire system.

From the general law noted above, we have the equation:

$e \times 1/8\, a = \text{or} > (e + f)\, 1/5\, b' + e \times 3/10\, a'' + d$, or reducing and substituting for a'' its value $3/8\ a$, $e \times 10\, a = \text{or} > (e + f)\, 16\, b' + e \times 9\, a + 80\, d$, or assuming $e = 6$ per cent. and $f = 4$ per cent., this reduces practically $6\, a = \pi > 160\, b + 8000\, d$.

Introducing factor two-thirds as in former deduction, and reducing equation becomes practically $a = \pi > 18\, b' + 886\, d$.

This means that on the basis of equal results as to light obtained and equal per cent. of loss in line, it will pay to adopt the 220-volt two-wire system, as against the 110-volt three-wire system, when the cost of copper as estimated for 110-volt two-wire system is greater than eighteen times the first cost of machinery of the 110-volt three-wire system, plus 889 times the extra annual cost of power for 220-volt lamps.

The saving in copper as between 220-volt two-wire and 110-volt three-wire systems is $\frac{7}{8}\, a = \text{or} > 2\frac{1}{4}\, b' + 111\, d$, and the above result can be expressed.

The saving in copper effected by 220-volt two-wire system over 110-volt three-wire system must be greater than two and one-quarter times first cost of 110-volt three-wire machinery, plus 111 times extra annual cost of power for 220-volt lamps.

This shows that the 110-volt three-wire system has generally the advantage over the 220-volt two-wire system, and that it will be rather an exceptional case when, as far as lighting service is concerned, it will pay to adopt the 220-volt two-wire system in preference to the 110-volt three-wire system.

THIRD:

The 220-volt three-wire system versus the 110-volt two-wire system. The first cost of the 220-volt three-wire plant machinery will be some greater than for 220-volt two-wire plant, and it will be safe to assume $b''' = 1.50\, b$, including cost of extra capacity, and the increased cost for three-wire system machinery.

The equation in this case becomes

$e \times 29/32\, a = \text{or} > (e + f)\ 5/10\, b + e\ 3/10 \times 3/32\, a + d$ which reduces, after introducing values for e and f, practically to $a = \text{or} > b + 20\, d$. Introducing factor 2/3 as before $a = \text{or} > 2/3\, b + 13\ 1/3\, d$, which shows there is a limiting case even here.

FOURTH:

The 220-volt three-wire system versus the 110-volt three-wire.

Here, as the plants are both three-wire plants we have $b''' = 1.20b'$, similarly to the case of the 220-volt and 110-volt two-wire systems.

The equation in this case becomes

$e \times 9/32\, a = \text{or} > (e + f)\ 1/5\ b' \times e + 3/10 \times a''' + d$; reducing and substituting for a''' its value $3/32\ a$ we have $e \times 90\, a = \text{or} > (e + f)\, 64\, b' + e + 9\, a + 320$ or $e \times 81\, a = \text{or} > (e + f)\, 64\, b' + 320\, d$; substituting $e = 6$ per cent. and $f = 4$ per cent., we have practically $a = \text{or} > 1\text{-}1/3\, b' + 66\, d$.

Introducing the quality factor 2/3 this equation becomes $a = \text{or} > 8/9\, b' + 44\, d$. The saving in copper effected as between 220-volt and 110-volt three-wire system is $9/32\, a = \text{or} > 1/4\, b' + 12\text{-}3/8\, d$, that is, the saving in copper effected by the 220-volt three-wire system over the 110-volt three-wire system must be greater than one-quarter first cost of 110-volt three-wire machinery, plus 12⅜ times extra annual cost of power for 220-volt lamps, to make it profitable to adopt the 220-volt system, as far as equal results in light obtained are concerned.

Any of the above results can be expressed in a different way as a function of number of lamps.

Take the first equation, $a = \text{or} > 1/3\, b + 16\ 2/3\, d$.

The cost of copper is proportional to the square of the average length of lines D^2, and to the number of lamps L, and can be written $P\, L\, D^2$, in which P is a factor equal to cost in dollars of unit cross section of wire.

The first cost of machinery, b, is a function of the number of lights, and $Q\, L$, in which Q is the cost per light of machinery in dollars.

The annual cost of extra power for 220-volt lamps d is also a function of the number of lamps, and can be expressed as $R\, L$, in which R is the annual cost per lamp in dollars of extra power required by 220-volt lamps.

Substituting these values in the foregoing equation, we have $P\, L\, D^2 = \text{or} > 1\text{-}3\ Q\, L + 16\ 2\text{-}3\ R\, L$, or striking out L we have $P\, D^2 = \text{or} > 1\text{-}3\, Q + 16\ 2\text{-}3\, R$, from which we see that the conditions are independent of number of lamps, and depend only on the square of the average distance from station to lamps.

Similarly—

Equation in case of three-wire 110-volt system versus two-wire 200-volt system can be expressed $P'\ D^2 = \text{or} > 18\, Q' + 889\, R'$, in which P, Q' and R' are factors corresponding to P, Q and R in the preceding case.

The foregoing results are, of course, applicable only when an economical and properly designed lighting service is the chief consideration. Where distribution of power is desired in conjunction with lighting, the advantage of the 220-volt system over the two-wire 110-volt system are greater than the results deduced herein allow. It is to be noted, however, that in the case of the 220-volt two-wire system as against the 110-volt three-wire system, the relative positions of the two systems are not changed from what is determined above, whether light alone or light and power both are furnished, since, as far as power is concerned, the two systems are on a par.

Taking lighting installations in general, however, the equations deduced herein will be found applicable, and where other considerations besides lighting service enter, they can be considered separately, and balanced against the results obtained by these equations.

As the distance over which current is supplied is the determining factor, it will be found that 220-volt installations will be more generally of value for central station installations than for isolated plants. With the three-wire 110-volt system it would be a very exceptional case where it would pay to install a 220-volt two-wire isolated plant.

Of course, the 220-volt system has important advantages over 110-volt systems where only a fixed amount of money is available and it is desired to make it go as far as possible, but such cases are not the ones considered in this discussion. We have here considered only the cases where there is sufficient money available to install a plant from a correctly engineered lighting standpoint.

The status of the 220-volt lamp will not, of course, remain where it is. Improvements will be made, and the efficiency be made better. On the other hand, improvements will also be made in 110-volt lamps, and in fully as great a degree, so that the relative status of the two lamps will be about the same as stated and assumed herein. The deductions herein can therefore be assumed as generally safe from much change.

The 220-volt three-wire system cannot at present be generally accepted as a practical one, as underwriters' requirements do not permit exceeding 330-volts pressure in buildings. This prohibits the system for isolated plants, and limits it in central station work to such an extent as to practically prevent balancing of the system.

There is no good reason why the underwriters should not permit 220-volt three-wire systems, provided satisfactory wiring and safety devices are used. Several such devices, including a magnetic cut-out, have been developed and placed on the market. It will probably, therefore, be only a question of time until the underwriters agree to permit 220-volt two-wire installations.

Until this permission is given, however, the 220-volt system can be considered as far as economical lighting service is concerned, a competitor of the 110-volt system only in case of two-wire installations in both cases.

Track Bonding—How Can We Obtain the Best Results.*

BY H. C. NEWTON.

The true importance of rail bonding, that is, the really significant factor it becomes in determining the cost of operaton of the road, is but indirectly realized, I am inclined to think, by the large majority of railroad men. The dimming of the lights on the car on which he is traveling over his road in the evening is a source of regret to the street-railroad manager always, for he realizes that there is something wrong; yet his conclusion generally is that there are some bonds loose somewhere, and his regret, when expressed, is most often for the decrease in the speed of his motors which accompanies the fall in voltage, not for the watts of electrical energy which are being consumed heating up bad track joints.

There is an old formula in elementary electricity, which if kept more constantly in mind by street-railway economists, would explain some of the obvious faults in the ground return and the extravagant fuel records which have appeared in some first-class street-railway power stations. This formula is that for the energy developed in an electrical circuit. It is expressed variously in terms of the current and voltage of the circuit as CE, in terms of the resistance and voltage as ER, or in terms of the resistance and current as C^2R. All or any one of these expressions may be used to advantage in calculating the magnitude of leaks, but they are all generally overlooked by the so-called practical man when reaching his conclusions.

An equipment consisting of a first-class 600-volt voltmeter and a 250-ampere ammeter, with a motor car and an accurate knowledge of the voltage carried at the station, is all the apparatus and data necessary to determine the quantities involved and to obtain with fair approximation the loss which is going on in the circuit outside of the motors and the generators at the station.

The first factor in the determination, viz., the loss in the trolley line, is, to some extent, a known quantity. You have already, or can figure easily, the resistance of the trolley and the feed, and by assuming a certain volume of current, the amount of energy lost, varying, of course, with the power consumed, is at once arrived at. The second factor must be obtained by the subtraction of the determined factor from the total loss. For this total loss your instruments come in play, and it is only by a series of readings on them with the car in motion on the road, and the determination thereby of the watts spent in running the motors, that a satisfactory result can be obained. The difference between the voltage, as shown on the voltmeter, and the volts shown on the voltmeter at the station, multiplied by the current, gives us this result. The difference between this result and the loss obtained for the trolley and trolley-feed lines by calculation should give us the loss in the track of the power employed for that individual car. The result is generally astonishing, especially if the traffic is heavy; and there are cities not a thousand miles from here where the sun of the horse-car rail is not yet set, where reading will show 50 and 60 per cent. loss at certain times.

To obtain the best results a rail joint should have an equal or better, a greater current-carrying capacity than the body of the rail itself. We have all heard this theory advanced before, but we are all bound to acknowledge that we have never seen it put in practice without it was on a new piece of electricity-welded track, on which the joints had not had time to break. Yet every city has portions of track through which a congestion of traffic and a consequent piling up of cars is forcing such a volume of current as to lead to serious power losses therein. The engineer will possibly remember of specifying 40 copper bond at a time the last piece of 9-inch girder was laid in the congested district, and of congratulating himself on thus getting what he thought was a first-class job of bonding. And yet, when he comes to consider that that rail has probably nine times the current-carrying capacity of the bond itself, and the bond is only riveted or upset in some way in the hole in the rail, and instead of having six times its cross-sectional area in contact with the steel of the rail it has possibly two, he will perceive that there is some reason to doubt whether he has such a first-class job after all.

With all due deference to the ideas of the track man, whose greatest glory is in a perfect roadbed, and to those of the electrical engineer, whose hobby is a complete trolley-feeder system with a theoretical loss of 5 per cent., I must yet insist on the importance of the rail return. Down in Syracuse we use the soldered bond, with no track feeders on the permanent way. The bonding is of 4 per cent. capacity and double throughout. The congested district of the city, the common centre, is not (as it should be) bonded to equal the capacity of the rail section. Our financial backing has not been educated to that extent as yet, and would regard such an outlay as extravagance. The whole track, however, is in such a condition, where the above-named bond has been used, that a low-reading voltmeter has failed at any time to detect a difference of potential between water pipes and rail, and the Western Union Telegraph Company, with its keen nose for electrolytic action, has been unable to locate a drop between their lead-covered return and the iron of the rail, the attempt being made with an instrument reading to 1-100th of a volt.

The importance of a true metallic return cannot be over-estimated. Where the chance for corrosion between bond and rail is allowed to remain the certainty of an interrupted contact one day is assured. The jar produced at the joint by the impact of the car-wheels results in vibration enough to loosen fish-plate bolts, and in the natural course of events must loosen rivets as well.

The rail should be one mass of continuous metal throughout to give permanency of electrical contact. It must therefore be homogenous. To make it so some process of brazing or soldering must be adopted. The former process has been found impracticable except in cases where it is possible to take advantage of welding currents, or return currents of immense volume. These can be obtained ordinarily only at the power station or by a large expenditure for special welding apparatus.

With these considerations in view the conclusion is forced upon us that the really practicable process is to solder the bond to the rail. Experience has proven it economical in first cost, and most desirable in the character of the results obtained.

The current-carrying capacity or the number and section area of the bond conductors should depend upon the location of the track, many and large for the crowded districts and at the points where the great volume of return current flows before entering the return feeders of the power house, of smaller number and capacity in the outlying districts.

With these provisions for perfecting the ground comes, as a matter of course, freedom from electrolysis and water and gas-pipe corrosion, and a saving in overhead negative feed lines, which should be of immense importance in the design of the permanent system.

*A paper read before the New York State Street Railroad Association, September, 1897.

DIGEST OF CURRENT TECHNICAL ELECTRICAL ARTICLES COMPILED FROM FOREIGN AND AMERICAN JOURNALS

BY CARL HERING

DYNAMOS, MOTORS AND TRANSFORMERS.

Alternating-Current Motor with Large Starting Torque. HEYLAND. *Elek. Zeit*, Aug. 26, translated in the Lond. *Elec. Eng.*, Sept. 3.—A reprint of a paper read at the recent annual meeting of the Union of German Electricians. He shows that the true torque is produced only by that component of a revolving field which is perpendicular to the axis of the winding, and that therefore it is possible to produce any desired starting torque if it is possible to produce in the short-circuited armature a field perpendicular to the exciting coil and of sufficient strength; the field is proportional to the voltage and indirectly proportional to the number of windings, from which it follows that to make the field strong the voltage should be high or the number of windings small. He describes with the aid of an illustration a method which he has devised for producing such an auxiliary field; the external stationary part of the motor containing the two usual coils contains also two auxiliary coils wound in the four spaces between those two coils; this auxiliary winding has but few turns; in this a large phase shifting will take place as that coil produces a large magnetic leakage; this field winding will produce in the short-circuited armature a very powerful starting torque perpendicular to the exciting coils proper; this starting torque may be increased by making the number of windings smaller; the special advantage of this method is that the motor remains the same as the usual single-phase motor and its dimensions are not in the least affected by the addition of this coil; no starting resistance is necessary in the main circuit, but there is a resistance in the short-circuited armature which is inserted by means of slide rings, but to avoid these a resistance may be put in the main circuit. The characteristic curves of such a motor are given, the tests having been made by Kittler; it is a 4-hp motor whose normal torque while running is 2 kg at one meter; the curves show that it will start at 5 kg, that is with 2.5 times the normal running torque, while as usually constructed the motors stop when overloaded 1.6 times; the torque is therefore increased considerably above the maximum torque it had before. In conclusion he claims that there is a large field for alternating-current motors for electric railways, as the alternating-current motor has advantages which are well understood if the starting torque can be made great; one of the advantages is that by the different connection of the windings the number of poles can be changed and therefore the speed. In the discussion which is published in the *Elek. Zeit.*, Aug. 5, Dobrowolsky stated that three-phase current plants were already in existence in large numbers, and he questions whether a satisfactory single-phase motor would change matters very much; he is of the opinion that it would not; an efficiency of 74 per cent. for a 4-hp motor is rather low; with three-phase currents an efficiency of 85 per cent. is easily obtained; the cosine of the angle of lag of this motor is 0.77, which he thinks is much too low; in three-phase motors it reaches as high as 0.90; a single-phase motor with an artificial phase can be made to give quite a high starting torque; it depends upon the effect of the starting current on the central station; as this motor has contact rings it should be compared with three-phase motors with contact-starting rings; if double the current would be no objection on a motor without contact rings, it would be better to omit these and use the three-phase current; he does not think this motor will compete with the three-phase motor, but it would be useful in existing single-phase installation. Goerges stated that with a three-phase current a large starting torque could be obtained by switching from the star to the triangle system and then back to the star system again; some years ago he made a test of a single-phase motor attached to an elevator, making it run at half speed by opening the circuit to the third brush; if, on descending, the connections are changed, the motor will deliver current to the system at half speed, thus acting as a brake. Arnold described a single-phase motor which he had built, and which had a higher starting torque with a lower current; it appears that it had a commutator, which, however, is used only for starting; the results for this 6-hp motor are given; the starting current is 1.5 times that at full load and the motor has about double the torque at starting, which is better than for the Heyland motor; it will run without sparks if the brushes are carefully adjusted; by inserting resistances its speed can be regulated. Heyland stated that his motor was only an experimental one and could doubtless be improved, making the efficiency 80 per cent.; the starting current is high because the torque is high; with 1.5 times the starting torque the current is only 1.7 times the normal. Goerges stated that with a choking coil he has often obtained the normal torque with 2.5 times the normal current; as a single-phase motor is supplied through only one phase the increase of current will be greater, while in the three-phase system the increase is distributed over the three circuits, thus giving less fall of voltage; if a 10-hp three-phase motor is allowed to be connected, then only a 3-hp single-phase motor would be allowed under the same circumstances; he experimented with motors with a commutator, but always obtained bad sparking, finding also that the position of the brushes must be very carefully adjusted. Heyland claimed that the effect of the increased current on the loss of voltage is precisely the same for three-phase and single-phase motors. Luxenburg called attention to the use of single-phase motors for railways, but claimed that the starting torque of the Heyland motor is not sufficient; that of the continuous-current motor is from eight to ten times the normal. Heyland replied that the starting torque of his motor may be made anything that is desired.

Variable Speed with Alternating-Current Motors. GEIST. *Elek. Zeit.*, Sept. 9.—A short communication referring to the above article by Heyland, in which attention was called to the phenomena that a single phase motor would run at various speeds below the normal. The present writer claims that this is well known, but that it is the case only when the distance between certain neighboring slots containing the winding is relatively larger than that between most of the other neighboring slots; undesirable currents and poles are then produced in the armature; the phenomena is characteristic of a short-circuited armature which is not acted upon as it should be.

Theory of Three-Phase Motors with a Variable Number of Poles. ZIEHL. *Elek. Zeit.*, Sept. 2.—An article discussing the method of changing the number of poles, and therefore the speed, by means of switches which change the connections, referring more particularly to a method which he devised which is similar to that of Dahlander (see *Digest*, May 29); in the latter method the coils overlapped. In the generators the same result may be obtained if the three phases are made to differ by 240° instead of 120°; such a winding is illustrated; he also shows such a winding in which the width of the coil is 180°; a disadvantage is that the self-induction and the magnetic dispersion are greater; he places a second winding symmetrically with the first, but shifted in position by 120°, and these two windings can then be combined in parallel or in series, as every two of the six currents are in the same phase; one of these windings could be used for lighting, and the other, quite disconnected from it, for power purposes. When applied to a motor the rotating field will be the same as in the usual three-phase motor, and the number of pairs of poles will be one-third of the number of coils; the revolving part will, therefore, without slippage have a speed which is inversely proportional to the number of pairs of poles; if the winding of each phase of one group is connected in parallel or in series with a corresponding one of the other group, so that they act as inducing currents, only half as many fields or pairs of poles will be formed and the number of pairs of poles will then be one-sixth of the number of coils; that is, the speed will be twice as great; he shows how this method can be applied in a very simple way to cause two different speeds to be produced; by a simple switching with a three-arm switch it is possible to go from one speed to the other; both of these connections are illustrated by diagrams; the resulting fields produced at various moments are shown diagrammatically and he discusses analytically the magnetization currents, torque, etc., for a motor connected for eight and then for four poles; he points out the advantages of connecting the circuits in parallel and describes a switch for that purpose.

Armatures with Teeth and Holes. FLEISCHMANN. *Elek. Zeit.*, Aug. 26.—A note referring to the recent article of Dobrowolsky (see *Digest*, Aug. 21), to which he desires to add that the tangential pull is not taken by all the teeth, but only by those "that lie within the region of commutation"; for this he offers a brief proof.

Armatures with Teeth and Holes. BAUMGARDT. *Elek. Zeit.*, Sept. 2.—A brief communication referring to the one by Bois (see *Digest*, Sept. 11), whose explanation, he says, fails in the most important case in practice, namely, when slotted holes are used.

Large Multipolar Dynamo.—Lond. *Elec.*, Sept. 17.—A brief, illustrated description of a French machine having an output of 3000 amperes at 125 volts and 200 revolutions; the poles are shunt wound, and the commercial efficiency is 94.2 per cent.; a table of the watts and outputs of a series of dynamos is given.

Dynamos. GUILBERT. *L'Eclairage Elec.*, Sept. 11.—Brief illustrated

descriptions taken from recent patents; they include the Parshall device for coupling alternators in parallel, a Siemens apparatus for showing which of the alternators is moving too slowly or too fast for coupling in parallel, the Greenwood, the Rees and the Frazer motors.

Engine and Dynamo.—Lond. *Engineering*, Sept. 10.—A brief illustrated description of a 20-kw engine and dynamo combined, constructed by a company in Holland.

LIGHTS AND LIGHTING.

Relation Between Arc Curves and Crater Ratios. Ayrton. *Elty*, Sept. 22.—An abstract of the British Association paper which was noticed in the *Digest*, Sept. 11.

POWER.

Electric Wagon Haulage.—West. Elec., Sept. 25.—A brief illustrated description of the application of stationary electric motors to assist in hauling the loaded carts up the inclined roadway in the deep foundation excavations at present carried on in Chicago. The motor operates through a windlass drawing a wire cable which is attached to the carts as they go up the incline; a 20-hp motor is used; the method is found to be more economical than steam hoisting, which is used in the same plant.

Electrical Power at Niagara Falls. Scott. *West. Elec.*, Sept. 25.—A reprint in part of the article which was noticed in the *Digest*, Sept. 18.

TRACTION.

Electric Traction on Canals. Dupuy. *L'Eclairage Elec.*, Sept. 11.—A very long, well-illustrated article describing the system of electric traction in use on the canal between Marles and Pont à Verdun, which has recently been started and which was constructed by the same company which had been experimenting on the Bourgogne canal (frequent references to which were given in the *Digest*). The current is supplied by means of overhead trolley wires; the canal is 26 km (15.6 miles) long; power is supplied by two central stations, each with a capacity of 200 horse-power; a complete map of the route is given, as also illustrations of details of the apparatus and of the station; the current is generated at 650 volts; the trolley consists of a two-wheeled chariot, which rolls on top of the wire; two systems of traction have been installed, one in which the boats are pulled by means of a sort of locomotive which travels along the towpath, it having three wheels, somewhat like those used on road engines; the wheels are driven by means of a worm gearing; the motors will generate normally 6 horse-power; the weight of the locomotive is 4400 pounds; in the second method the motor is placed in the rudder of the boat, and drives the propeller directly, the propeller being at the end of the rudder; the speed of the propeller is 300 revolutions per minute. The complete tabulated cost of the whole installation is given and it amounts to $5400 per km; the price per electrical horse-power is $122.8; the locomotive costs $1140 and the rudder propeller $1260; the total movable machinery costs $1710 and the stationary installation $3675 per km, that is, in the ratio of about 1 to 2.1. The results of the tests made by the Belgian Government on the Bourgogne Canal are given in detail; with 100 tons the speed was 300 meters per hour; with the propeller a speed of 400 meters per hour was obtained with 70 tons, the current being 5 to 15 amperes at 300 to 350 volts; a full-page table of the results is given. After comparing the propeller and the locomotive systems, preference was given to the latter as the efficiency is higher, and several boats can be drawn by the same locomotive; there are, however, some advantages in favor of the propeller, as it does not require the maintenance of a towpath, avoids the use of towing ropes and the consequent detention when boats meet; the energy required for the locomotive is about 10 to 12 amperes at 300 volts, while for the propeller 14 to 15 amperes were required at 250 to 280 volts. Estimates of the cost per boat kilometer are given on the basis of 100-tons per boat and are divided among those for (1) traction, (2) attendance and maintenance, and (3) amortization and interest; these are 0.2, 1.4 and 1.2 cents, respectively, making a total of 2.8 cents under normal conditions; the price paid at present on this canal (presumably meaning with horse traction) is 10 to 12 cents, thus leaving a very large margin of profit for the new system.

Comparative Cost of Conduit and Accumulator Traction. Braun. *Elek. Zeit.*, Aug. 26.—A long abstract of a recent paper in which he compares the cost of a mixed system of overhead and accumulator traction and of overhead and conduit traction, basing his figures on the Siemens & Halske lines in Budapest and Berlin. The cost of a conduit system is given as $15,000 per km for a single track including the construction of the conduit in asphalt streets, including the tracks and all materials but not the opening and repairing of the street pavement; although this cost is high, the cost of operation is very favorable, as the maintenance and attendance, including cleaning, is only 4.5 per cent. of the cost of installation. He assumes a double-track line, of which 4 km is provided with the overhead trolley and 1 km with the conduit system on the one hand, and with accumulators on the other, and he finds that the first cost for both is about the same; the cost of operation, however, is different; as an accumulator car weighs 2.5 tons more than a motor car and as it takes 45 watt hours per ton kilometer, the yearly excess of energy required by the accumulator car, after making certain allowances, amounts to about 5000 kw-hours, to which he adds the cost of maintenance of the battery and obtains a cost of operation of about $3880 for the mixed accumulator system as against $1910 for the mixed overhead and conduit system, or roughly the cost of the latter is half as great.

Position of Motors for Electric Railway. Grove. Lond. *Elec. Rev.*, Sept. 17.—A communication criticising the views recently expressed by Baxter in The Electrical World. It is claimed that a comparison of the Liverpool and the American street railways is apt to be misleading, as the former is for heavy electric-railway work; he argues that where trains consist of several cars the advisability of motor cars is more doubtful; a double equipment means undesirable expense, and there are objections to the rear car pushing; an electric locomotive of 300 to 400 horse-power costs less for construction and maintenance than an equipment of motors aggregating this power in from eight to twelve machines; he believes that the locomotive is the only practical solution of such a problem. In the Waterloo and City railway four-car trains will be used, with the motors on the first and last car.

Cost of Electric Traction.—Lond. *Elec. Rev.*, Sept. 17.—A brief abstract of some figures in the *Railway World*, Sept. The proportion of expenses to receipts for the Liverpool line is 63.18 per cent., for the City and South London line, 55.64, and for the Edinburgh cable line, 57.72 per cent.; the average passengers, per car or train mile in the three cases, were 12, 14 and 10; the average cost per passenger carried, per mile, was 2.5, 2.28 and 1.2 cents respectively.

Electric Railway at the Paris Exposition of 1900.—L'Ind. Elec., Sept. 10.—As was stated in The Electrical World last week, there is to be a prize competition of projects for the construction and operation of an electric railway for transporting the visitors to the exhibition grounds; the present note gives the details from the official circular regarding this competition.

Electric Railways in Budapest. Braun. *Elek. Zeit.*, Sept. 9.—A reprint of a very long paper accompanied by sixteen illustrations, on the various electric railways in that city, including the trolley, conduit and underground (tunnel) systems; the paper was read at the annual meeting of the Union of German Electricians.

Railways in Brussels. Scott. Lond. *Elec. Rev.*, Sept. 17.—A brief illustrated article calling attention to some of the features in this system of electric railways.

Electric Locomotives in France.—Lond. *Elec. Eng.*, Sept. 17.—A note stating that the electric locomotive "will be an accepted and working factor of the Western Railway of France" beginning with the second half of May next year.

Electric Locomotive.—Lond. *Elec. Rev.*, Sept. 17.—A more detailed description, with numerous illustrations, of the one referred to in the *Digest*, Sept. 18.

Electric Motor Cabs in New York. FitzGerald. Lond. *Elec. Eng.*, Sept. 17.—A short article in which he endeavors to deduce comparative data from the published articles; the comparison is difficult owing to the nature of the original information; he however arrives at the following figures: that 1 effective horse-power is obtained from 300 pounds of battery; 1 effective horse-power hour from 100 pounds of battery; 1 mile-ton (0.3 hp-hour) is obtained from 30 to 33.3 pounds of battery. A diagram for a traction weight of 2000 pounds and a battery of 900 pounds is given, showing the decrease of distance with speed, and the increase of amperes with speed; no great degree of accuracy is claimed; it appears that the amperes under constant voltage vary approximarely as the speeds.

Safety Third-Rail System.—Elec. Eng., Sept. 23.—An illustrated description of the Crocker system, which has been tried experimentally on a small scale; its object is to render the exposed rail harmless and to prevent short circuits; the rail is divided into sections, which are alive only while the car passes, being controlled by switches placed in boxes in the ground at short intervals.

Fire in the Railroad Shops in Brooklyn. Hobart. *Elec. Eng.*, Sept. 23.—Some object lessons in car shop and shed building which can be learned from the recent fire in Brooklyn.

Locomotives for the Jungfrau Railway.—Elec. Eng., Sept. 23.—An abstract of the article noticed in the *Digest*, Sept. 11 and 18.

Preventing Railway Joints. Allen. *West. Elec.*, Sept. 25.—A reprint of a short article read at the New York State Street Railway Association.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Free Supply of Incandescent Lamps. Gibbins. Lond. *Lightning*, Sept. 9.—A short article giving briefly the results of the experiment which has now been tried in Bradford for nearly a year, and which consists in the central station supplying a lamp free to the customers for a certain quantity of current consumed; the results were very gratifying and proved equally advantageous to the consumer and to the central station. The calculations are based on 3.5 watts per candle power and 1000 hours; the conditions are that the accounts must be paid within two months after they are due or any rights to new lamps for the previous half year are forfeited; where arcs and incandescents are used, the former must be placed on separate circuits. One of the objects of the system was to ensure that the lamps which had reached the "smashing" point should be discarded in favor of new ones; also that the consumer was then provided with the best lamps obtainable; the anticipations have been more than

fulfilled; the outstanding accounts were reduced to less than 8 per cent. and this represents electricity used for other purposes than lighting; the consumers have therefore been encouraged to settle their accounts promptly; the purchase of cheap inferior lamps of the German type has been stopped almost entirely; consumers having lamps on hand replace old ones at once; the quality of light is always the best, as worn-out lamps are replaced more promptly. The consumer shows his receipted account to the storekeeper at the station and receives the number of lamps to which he is entitled, and he alone is responsible for them after this; no old lamps are taken in exchange; the storekeeper makes a simple calculation, consisting of dividing the number of units corresponding to the candle-power of the lamp (60 units for one 16 cp lamp) into the number of units consumed for incandescent lighting.

Electric Lighting of Railroad Stations.—Elek. Zeit., Aug. 26.—Tabular matter concerning the cost of operation of the lighting plants in the government railroad stations in Austria.

Central Stations.—Elek. Zeit, Sept. 9.—Three long abstracts from reports on the operation, one for Berlin and one for Vienna; the third is for a proposed station at Munich.

Frankfort-o.-M.—Elek. Zeit., Sept. 16.—A long abstract, with tables, from the report of the second year's operation of this alternating-current station.

Vienna.—Lond. *Elec. Eng.*, Sept. 17.—Abstracts of the annual report for 1896, giving some statistics.

WIRES, WIRING AND CONDUITS.

Interior Conduit.—Lond. *Elec. Rev.* and *Elec.*, Sept. 17.—An illustrated description of the new conduit made by an English company. The principal difference between it and the usual system is that the external and internal diameters are now the same as those of ordinary gas pipe, both the armor and the lining having been diminished in thickness; the pipe is a Mannesmann steel tube and the lining is more of a textile nature, being, therefore, more flexible and less brittle; the screw threads on the pipes are lighter and have less pitch; a joint box is illustrated in the former journal.

Wiring Rules. O'GORMAN. Lond. *Lightning*, Sept. 9.—A criticism of the recent Institution rules, calling attention to a number of questionable points and making some suggested additions.

ELECTRO-PHYSICS AND MAGNETISM.

Mechanism of Electrical Phenomena. WEYDE. *Elek. Zeit.*, Aug. 26 and Sept. 2.—A long, well-illustrated article, in which he endeavors to develop the mechanical theory of electricity suggested by Maxwell, and to apply the hypothesis also to the explanation of contact, thermo and decomposition electricity, with the aid of a large number of diagrams representing the electrical molecules or atoms; the article does not admit of being abstracted, as the numerous illustrations form the most important part. He imagines a magnetic field to be filled with whirling elastic molecules, all of which revolve in the same direction, and in virtue of the rotation they expand in the direction of the equator, while in the axial direction they contract. By means of these diagrams he explains the mechanism of magnetic actions, of electric currents, electro-dynamic induction, electro-magnetic induction, contact and thermo-electricity and the galvanic current. In connection with contact electricity he imagines that one of the conductors contains the molecules in a loose condition, while in the other they are condensed; on contact, there is an equalization of the two conditions, causing some of the little particles between these molecules (representing the electric atoms) to pass from one to the other. The suggestion that in the various metals the ether molecules vibrate at different speeds he explains by the suggestions that the spaces between the molecules may be different in the various metals and of different forms. He also explains the mechanism of electro-dynamic and electro-magnetic actions. Anyone interested in this subject will probably find this article well worth reading.

Conductivity of Carbon for Heat and Electricity. COLLIER. *Elek. Zeit.*, Sept. 9, noticed briefly from the *Wied. Ann.*, 61, p. 511.—According to Weber there is a certain simple relation between the electric conductivity and the specific heat of metals; the present author endeavored to find whether there is a similar relation for carbon, and found that such a relation did not exist.

Discharge Potentials. SWYNGEDAUW. Lond. *Elec.*, Sept. 17.—Abstracted briefly from the *Jour. de Physique*, Sept.—The conclusion of his work on spark potentials (to which frequent references have been given in the *Digest*); he proves that when the knobs are polished and placed beyond reach of the ultra-violet rays, then the static and dynamic discharge potentials are equal; the proof is indirect; the abstract states that his conclusions are not convincing, but show the delicacy and difficulty of these determinations; the most valuable result is said to be that when all the precautions are observed the sparks pass with unexpected regularity.

Electrical Convexion. PICTOU and LINDER. *Zeit. f. Elektrochemie*, Sept. 5; an abstract from the *Journal of the Chemical Society*, 414, p. 568.—They describe researches made with various solutions and pseudo solutions, showing different directions of the wandering of the substances.

Change of Color of Salts Due to Cathode Rays. ABEGG. *Elek. Zeit.*, Sept. 9.—A abstract of the article noticed in the *Digest*, last week.

Luminescence of Gases. SAGNAC. Lond. *Elec.*, Sept. 17; noticed briefly in the *Comptes Rendus*, No. 3, July.—He investigates the influence of air and other gases on X-rays traversing them; if X-rays are diffused by gaseous molecules their wave length must be of the same order of magnitude as the molecules themselves unless the corpuscular theory of X-rays is adopted; he also endeavors to show a connection between the conductivity of gases under X-rays "and that of illuminated sulphur and selenium."

Insulation of Micanite.—Elek. Zeit., Sept. 2.—Results of some tests made by the Reichsanstalt. For a thickness 0.3 mm a voltage of 18,000 was required for piercing it; for 0.1 the voltage was 4300; the resistance after three minutes' electrification is also given: for 0.3 mm at 2000 volts it was 2,000,000 megohms, for 0.1 mm it was 7,900,000 megohms.

Magnetic Properties of Iron from Sand. WILSON. Lond. *Elec.*, Sept. 17.—The results of tests, including chemical analysis, of wrought iron made from iron sand in New Zealand. The iron seems quite pure; magnetically it is slightly superior to the Lowmoor iron, but neither is as good as pure iron; it may be considered equal to the best English wrought iron as far as high induction density is concerned, but it is slightly inferior to the best grades of forged steel castings; it is about normal in loss due to hysteresis.

Magnetization of Steel and Iron by Small Forces. HOLBORN. *Elek. Zeit.* Sept. 9.—An abstract containing the curves and data from a recent contribution from the Reichsanstalt; the object of the research was to make a careful investigation on well-defined material of the law announced by Lord Rayleigh that the coefficient of magnetization for small forces is approximately constant; also the suggestion by Bauer that this coefficient for all kinds of iron is in the form of a straight line for increasing field strengths.

Calculation of Electro-magnetic Tractive Force. NATALIS. *Elek. Zeit.*, Sept. 9.—A communication referring to the recent article by Vogelsang (see *Digest*, Sept. 18); he praises the article, but states that the formula was deduced from the condition of motion, while the attraction also exists in a state of rest; furthermore it refers, strictly speaking, only to electro-magnets, and not to permanent magnets; the present writer, therefore, endeavors to deduce a formula for the static condition, basing it on the definition of the unit of magnetism; the deduction is exceedingly simple. He also shows that the usual definition of the magnetic quantities does not seem to agree with the formula of Maxwell, the values from which are half as great. An editorial notice states that this discrepancy is only apparent.

Constants of the Earth's Magnetism. ESCHENHAGEN. *Elek. Zeit.*, Sept. 9, noticed briefly from the *Wied., Ann.* 61, p. 411.—He gives the constants for 1896 at Potsdam, Germany.

Radiation of Light in the Magnetic Field.—Elec. Eng., Sept. 23, reprinted from *Nature*.—A brief summary of the researches made during the past months with the phenomena first noticed by Zeeman.

Model for Illustrating Hertzian Waves. S. P. THOMPSON. *Elec. Eng.*, September 23, reprinted from *Nature*.—An illustrated description of the model, a brief description of which was given in the *Digest*, recently.

Constitution of the Electric Spark. SCHUSTER. *El'ty.*, Sept. 22.—An abstract of the British Association paper which was noticed in the *Digest*, Sept. 11.

ELECTRO-CHEMISTRY AND BATTERIES.

Electric Engraving. LANGBEIN. *Zeit. f. Elektrochemie*, Sept. 5.—A brief description of the Rieder process for which a German patent was recently issued. It is an entirely new method of engraving on steel and other metals for the purpose of making dies, such as are used for stamping coins. A cast of the coin is taken in plaster of Paris on the end of a cylindrical block of this material, surrounded by a hard rubber tube; this block is placed in an electrolyte so that the lower part is immersed in the liquid, the relief of the coin being on the upper part, which is not in the liquid; the negative pole is connected to an electrode in the liquid; the piece of steel to be engraved is connected to the positive pole and is laid on the upper part of the cast; the current will then dissolve the metal wherever it is in contact with the moist cast, the metal sinking down lower as it is dissolved, until all portions of it are in contact, the engraving being then finished. In carrying out the process many difficulties were encountered, but it appears that these have now been overcome; he uses 10 to 15 volts and 0.2 to 0.5 ampere per sq. cm.; the electrolyte is chloride of ammonium, which is first formed by the electrolysis with an iron anode; getting rid of the particles of carbon which are not dissolved requires frequent cleaning, involving the difficulty of getting the metal back into exactly the same position; alabaster gypsum is used, but is apt to get soft; a machine was constructed which washes off the carbon particles automatically.

Electricity Direct from Carbon.—Zeit. f. Elektrochemie, Sept. 5.—The beginning of an illustrated editorial article (Borchers is the editor in charge) giving abstracts of various articles and researches, some of which were published and others were not during the past ten years. The first part refers to an American work which has already been fully noticed; a long abstract with illustrations is given of the Mond and Langer paper, read at the Royal Society of London in June, 1889, describing a gas battery; this is followed by an illustrated abstract of a German patent of 1888 to Scharf,

also for a gas battery; a closed cylinder contains a number of cells in series made of carbon plates, the gases and electrolyte being admitted and withdrawn through tubes.

Theory of Lead Accumulators. Liebenow. Lond. *Elec. Eng.*, Sept. 17.—A brief reference to a recent paper describing experiments to prove the existence of lead dioxide in the ionic condition, as required by his theory of lead accumulators; the original source is not given.

Theory of Lead Accumulators. Elbs and Schoenherr. Lond. *Elec. Rev.*, Sept. 17; abstracted from the *Chemiker Centralblad*, 1895, p. 591.—They claim that persulphuric acid takes an important part in the action of a cell, and they therefore determined the relationship between the amount formed and the concentration of the sulphuric acid; if the density is below 1.2 very little persulphuric acid is formed; too great a concentration also retards the formation of that acid. An article by Elbs in the same journal is also abstracted, it being on the same subject; he demonstrates the formation of persulphuric acid.

Thallium. Foerster. *Zeit. f. Elektrochemie*, Sept. 5, noticed briefly from the *Zeit. Anorg. Chem.*, 15, p. 71.—To recover the 1 per cent. of thallium from the dust of certain furnaces, this dust is boiled, then precipitated with common salt, the precipitate being then converted into sulphate to free it from the arsenic, after which the solution is electrolyzed.

Nitrogurete. Pauli. *Zeit. f. Elektrochemie*, Sept. 5.—In 1841 Grove claims to have obtained combinations of metals and nitrogen by an electrolytic process; the present writer repeated the experiments and found that such combinations were not produced.

Carbon Cell. Borchers. *Elec. Eng.*, Sept. 23.—One of the illustrations, accompanied by a brief description, of the battery described in the article which was abstracted in the *Digest* Aug. 21 and Sept. 18.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Tangent Phase-Meter. Arno. *L'Eclairage Elec.*, Sept. 11.—A long abstract of a paper from the Italian, containing an illustrated description of the instrument. He shows that the tangent of the angle of lag can be represented by the product of a constant and a certain factor, which latter can be measured by the instrument described; this consists of an electro-dynamometer with a fixed coil and a movable one, the latter being brought back to its zero position by means of a spring, as usual; inside of these two coils, and concentrically with them, are two other coils, perpendicular to each other and rigidly connected with each other; they are also suspended by springs and a tortion head; like the movable coil they may be brought back to the zero position and their circuit may be opened or closed by means of a key; the circuit is first opened and the two currents whose phase difference is to be measured are passed through the two electro-dynamometer coils; after bringing the coil back to the zero position and reading the angle, the circuit of the other two coils is closed and the instrument then develops a rotating Ferraris field tending to turn the short-circuited coils; these are then brought back to zero; the ratio of the latter angle to the first one measured, multiplied by the constant of the instrument, will then give the tangent of the phase difference, provided the currents are sinusoidal. By winding the electro-dynamometer coils with fine or coarse wire, the instrument may be used with small or large currents or as a wattmeter.

Theory and Application of the Phase-Meter. Teichmueller. *Elek. Zeit.*, Sept. 16.—The first part of a mathematical article giving the theory of these instruments. Although the principle has been applied to motors yet comparatively little use has been made of its application to instruments for measuring the phase angle; Dobrowolsky constructed such an instrument some years ago, but it is not used largely in practice.

Tracing Alternating-Current Curves. Eichberg. *Elek. Zeit.*, Sept. 9.—A short article describing an apparatus to be used in the Joubert method, and which he thinks will give better results than the one described recently by Marcher (see *Digest*, May 8), it being simpler. The apparatus consists essentially of a drum of insulating material having on its surface a contact strip of even thickness in the form of a screw thread of exceedingly great pitch; there are also two narrow brushes, the ends of which are cut off in a slanting direction, the brushes being moved parallel to the axis of the cylinder by means of a screw driven by gearing from the cylinder, their lateral motion being therefore in a fixed proportion to the revolutions of the cylinder; the motions must be very regular and the contract strip must have a constant thickness, which latter can be easily calibrated by means of a continuous current by a method which he describes and in which a continuous current is used, when a galvanometer in circuit should give the same deflection for every position of the brush. The curves may be determined either by means of points or in a continuous form in a few seconds.

Tracing Alternating-Current Curves. Armagnat. *L'Ind. Elec.*, Sept. 10.—The conclusion of his article (see *Digest*, Sept. 18), giving descriptions of the different forms of apparatus and the results obtained.

Determining Magnetic Hysteresis Loss in Straight Iron Strips. Fleming. Lond. *Elec. Eng.*, Sept. 17.—The beginning of a reprint in full of his Physical Society paper, which was noticed in the *Digest*, July 3.

Determination of Moisture in Soils.—Elec. Eng., Sept. 23.—A very brief abstract of Bulletin No. 6 of the U. S. Agricultural Department, which mentions the following process: specially constructed electrodes are buried in the soil and the resistance through the soil is then measured, from which the amount of moisture can be determined. The soil is regarded as a difficultly soluble compound and the soil moisture as a salt solution derived therefrom.

Alternating-Current Meter Litigation.—El'ty, Sept. 22.—A statement of the present status of this litigation.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telegraph Call. Wetzer system. *Elek. Zeit.*, Aug. 26.—An illustrated description of this system, intended to enable any operator to call any other on the same line, without disturbing the others. The calling apparatus contains a pendulum which by an adjustable weight is made to vibrate at any desired definite rate; at the calling station it is vibrated by means of an electro-magnet, the construction of which is shown; the number of vibrations is different for each of the stations, and at the calling station it is determined by setting the weight so that the vibration will correspond to that of the station to be called; after about twelve oscillations the pendulum at the calling station will then vibrate, and this will cause the call bell to ring.

Telegraphy without Wires.—Lond. *Elec.*, Sept. 17.—Two articles, the first being a long abstract of Marconi's British patent, No. 12039, 1896. The second article is a short illustrated description of the apparatus which was shown by Lodge to the British Association in 1894, from which it appears that he had shown substantially the same system as that which is now claimed in the above-mentioned patent.

Telegraphy without Wire. Hertz. *Elek. Zeit.*, Sept. 2.—A reprint of a brief letter of the late Hertz, in which he gives his views concerning telegraphy by means of Hertzian waves, without wires.

Speed Tests in Telegraphy.—Elek. Zeit., Aug. 26.—An abstract from the *Jour. Télégraphique* of an article by Lany, giving the results of speed tests made in Belgium with a Hughes apparatus, Morse sounders and the telephone. These are presumably the same tests which were referred to some time ago.

First Practical Telegraph. Preece. *Jour. Inst. Elec. Eng.*, July.—A very short account, with an illustration, of what is claimed to be the first system of telegraph wires which was laid on the permanent way of the London & Birmingham Railway by Cooke in September, 1837, and is thought to be the first practical telegraph line ever constructed. It consists of five wires and is fitted with five needle instruments; a plank of wood of trapezoidal section contains five deep grooves into which the wires were laid, the grooves being then filled up with a piece of wood. A portion of this line was dug up a few years ago and was used on June 22, 1897, to form a portion of the circuit through which the Queen signalled her instructions to forward her message to all the colonies. Copies of the accounts of the cost are also reproduced.

Block Signals for Single-Track Railroads.—Zeit. fuer Elek., Sept. 1.—An illustrated description of a system made in Germany.

Binghamton Telephone Exchange. Gardner. *Elec. Eng.*, Sept. 23.—An illustrated description of the Bell company's station in that city.

Microphone.—West. Elec., Sept. 25.—A reprint of the article describing the Guyomard and Rolland microphone, which was noticed in the *Digest*, July 10.

MISCELLANEOUS.

Recent Researches with Ozone. Prepognot. *L'Ind. Elec.*, Sept. 10.—A very long illustrated article, being an abstract of a recent thesis by Otto. In the first portion he verifies the formula of ozone, namely, that it contains three atoms of oxygen; several experimental verifications are described. He then deals with the quantitative analysis by the chemical and physical methods, including the determination by iodide of potassium and the volumetric method, in which ozone heated to 250° C. decomposes, changing its volume. He then describes the preparation of ozone, giving the results of what appear to have been very extended researches with the electrical method; he first endeavored to determine the voltages which should be used for given thicknesses of dielectrics; his results are given in curves; experiments are described made with two concentric tubes with an air space between them, the inner being filled with tinfoil and the outer one covered with the same material, the gas being passed between the two; this simple apparatus is very good for experimental purposes, and can be used to produce very concentrated ozone, 80 to 85 mgr per liter; another form similar in principle, though differing in construction, is described, and is said to answer well for producing small quantities; the chief difficulty encountered is that the thickness of the glass separating the electrodes is not sufficient to prevent the formation of a short circuit, and they are therefore not suitable for commercial application; this is claimed to be the weak point in all ozonizers; he shows that in an ozonizer the discharge should be oscillating; tables and curves are given showing how the yield in ozone increases with the frequency; in an oscillating discharge, the duration of the periods between groups of oscillations is relatively long, and the apparatus is therefore active during only a short part of the time; by increasing the frequency the efficiency is increased proportionately, but the power is not increased in the same proportion, as the current is better utilized; he deduces the

law that the efficiency in ozone is proportional to the number of periods of the alternating current. A dielectric makes the output more regular, but it consumes energy, which lowers the efficiency; this efficiency in those apparatus which can be cooled does not exceed 5 per cent.; the best efficiency so far obtained is with the Otto apparatus, and does not exceed 15 per cent.; experiments are being made with the view of doing without the dielectric, which consumes so much energy; he hopes soon to prove that high efficiencies in ozone will only be obtained when it is possible to construct a discharging apparatus which will operate without a dielectric, so that all the energy which it receives can be taken up by the oxygen.

Observations of Lightning Rods. MESSING. *Elek. Zeit.*, Aug. 26.—A note describing an observation showing that lightning rods act as silent dischargers through their points. While constructing a lightning rod on a chimney 100 feet high, the workmen were surprised by a thunder storm before the rod was completed; a provisional wire was therefore run from the rod to a neighboring pond, and it was noticed that during the storm considerable gas was formed on the part of the rod which was in the water, which showed that considerable current was passing through the rod. He also suggests a simple experiment, in which a lightning rod is cut two meters above the earth and the ends connected with a plate lightning arrester and with a galvanometer or an electric bell, and it will be found that the galvanometer will show an almost constant deflection or that the bell will often ring, showing that there is a continual equalization.

Silent Discharge Through Lightning Rods. C. HERING. *Elek. Zeit.*, Sept. 16.—A communication forming part of the recent discussion in that journal on lightning rods (see *Digest*, Sept. 4); in this discussion it was claimed by several speakers that the rods did not act as silent dischargers; the present writer described an incident showing that they do. While on the top of one of the high Alps during the approach of a storm the silent discharge took place through his fingers when held above the head, in the form of long, blue sparks; this he claims shows that lightning rods do act as silent dischargers. An editorial note adds that while this is conclusive, there is still a doubt as to whether such a discharge takes place to an appreciable extent under the usual conditions where lightning rods are used.

Battery Jars of Pegamoid.—L'Ind. Elec., Sept. 10.—A brief description of a new product having this name; it is said to be a material which, when applied to asbestos, papers, cardboard, etc., makes them impermeable, insulating, washable, resistant against grease and acids and not affected by great changes of temperature; the materials are impregnated with celluloid dissolved in alcohol and then heated in appropriate moulds, whereby the alcohol is evaporated and the material takes the form of the mould. For making battery jars, asbestos, paper or cardboard is used; the material is impregnated with a liquid celluloid, the joints being stuck together with the same material; they are also made by mixing one part of liquid celluloid with two parts of powdered or fibrous asbestos; the material is also applied to belts for transmitting power; attention is called to the question of its inflammability.

Electricity in the Navy.—Lond. *Elec.*, Sept. 17.—An editorial article urging that more extensive use of electricity be made in the British Navy.

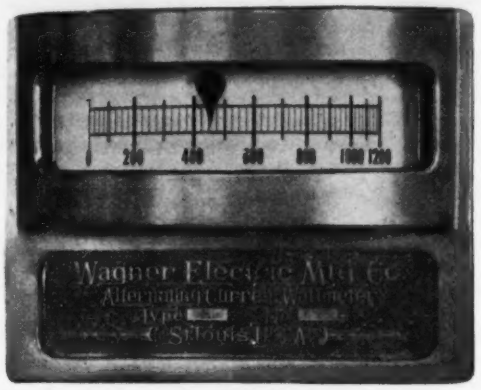
Training of Electrical Engineers in Germany. SCHMIDT. Lond. *Elec. Rev.*, Sept. 17.—A summary of a recent report.

British Association Meeting.—Lond. *Elec.*, Sept. 10.—A running account of this meeting, with brief abstracts of some of the papers, a number of which have been and will be noticed in the *Digest*, under their respective headings; the abstracts are mostly very brief; a complete list of the electrical papers is also given in the same issue. Abstracts of a few of the papers are also published in the Lond. *Elec. Rev.* and *Elec. Eng.*, Sept. 10.

Alternating-Current Switchboard Instruments.

One of the most crying and heretofore unanswered needs in alternating-current central-station equipment has been a reliable dead-beat, wide-scale, indicating switchboard instrument. There have been many so-called "satisfactory" instruments built for central-station use, but in every instance these have met with unlimited criticism, and have only been retained in service because the market afforded nothing better. The Wagner Electric Manufacturing Company, St. Louis, Mo., now announces, however, a line of indicating voltmeters, ammeters and wattmeters which are said to meet every objection raised against the alternating-current instruments heretofore available. These instruments are a radical departure in design, both mechanically and electrically, and embody features absolutely requisite to a first-class instrument for station work.

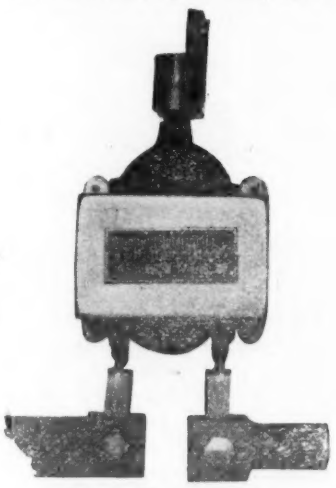
A switchboard instrument which cannot be relied on is worse than useless. It is detrimental to the entire station service. Inaccuracy arises from many causes. One frequent source of such trouble is that a horizontal shaft, swinging either on knife edges or in jewel bearings, has imposed on it so great a weight as to give rise to excessive friction. The immediate consequence is that no two consecutive readings exactly the same can be secured with the same deflecting force. Another source of trouble is that a principle of action affording very small deflecting force in a reasonable amount of space for operating parts is made use of, with the result that the friction and deflecting force approach each other in value, and reliable readings are impossible. In many instances instruments read fairly well when delivered, but in a month's time the thin skin of oil on the pivots or knife edges, which is quite essential to satisfactory action, has worn off, rust sets in, and accuracy disappears. Sometimes the active windings of the instrument are so highly inductive that a small change in the current frequency from that on which the instrument was calibrated throws the scale 5 to 25 per cent. off the standard. Appreciating all these shortcomings from having endeavored to give patrons for whom central-station switchboards were manufactured satisfactory instruments regardless of cost or name of manufacture, this company determined to design a complete line of ammeters, voltmeters and wattmeters, and at once began their manufacture. The line as now announced is one which can be and is guaranteed to give satisfaction in every direction. Accuracy is provided for by a form of mechanical construction and electrical design altogether novel. First of all, the moving parts are carried on a vertical shaft, the lower point of which runs in a jewel bearing. This point is at all times immersed in oil, and accordingly friction is reduced to a minimum. Secondly, the deflecting force is so very great that every point on the scale has a positive differential value, and successive deflections, with the same deflecting force, are absolutely the same. Furthermore, the induc-



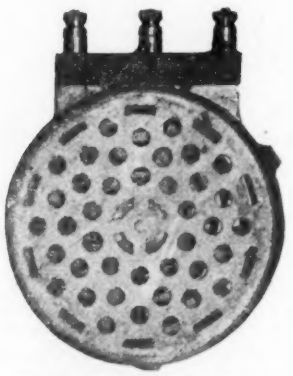
THE AMMETER.

tive error is eliminated, voltmeters, for example, reading practically the same on direct current as on alternating current of 16,000 alternations. Finally, every scale is accurately plotted by independent calibration, and as there are no parts the constant of which is subject to change indications are permanently reliable.

A great source of annoyance with alternating-current instruments has been that the indicating needles would continue oscillating for several minutes after any disturbance on the line. With voltmeters on circuits which station practice made necessary to throw over from one machine to another as loads varied, so serious would this vibration prove that for half a minute or more after throwing over no reliable reading could be made. In the Wagner instruments this defect has been wholly eliminated by floating all the moving parts in a light, colorless, odorless oil, a couple of small aluminum vanes serving to afford a damping action by which needles are held stationary against any passing, instantaneous disturbances, and at



SERIES TRANSFORMER.



SERIES RESISTANCE CUP.

once brought to rest on throwing over. Station men who have examined the instruments have been particularly impressed by the fact that dead-beat action has been secured without sacrifice to the least extent of sensitiveness. No instruments outside the laboratory could be more sensitive than these.

That the instruments are economical in operation is apparent from the statement that the voltmeter consumes but seven watts on 110 volts pressure. The ammeters introduce practically no resistance in the circuits into which they are inserted. Nothing more could be desired from the standpoint of economy of operation.

Recognizing that the proper illumination of the instrument scales should come from the rear rather than the front of the board, admirable provision

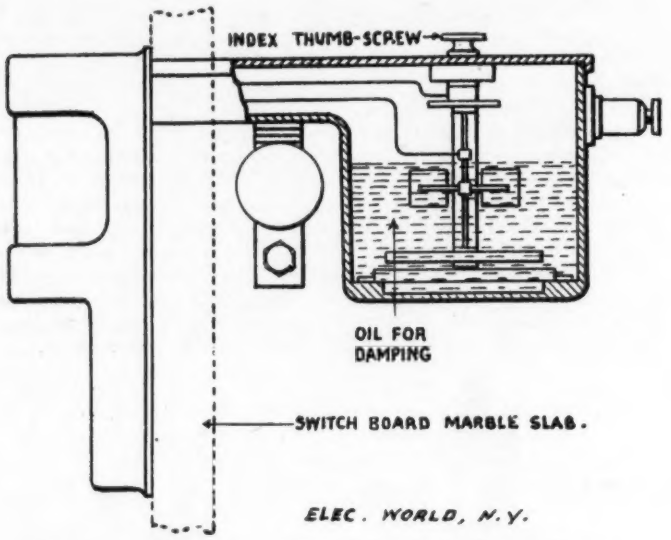
has been made for this. The lamps, two in number for each instrument, are eight candle power, 50 volts each, connected two in series and mounted on a special bracket which holds them in the necessary position for perfect illumination of the scales. The position of the lamp is evidence of the excellence of the illumination, and the highly glazed opal glass on which the scales are drawn, being bent into the arc of a circle, by virtue of its shape alone diffuses the light thrown upon it over the entire surface. At the same time the instrument dial is so beautifully lighted up that the rear of the board is illuminated perfectly.

All that could be claimed along this line is evident from the illustrations herewith. The body of the instrument, which extends through the board, is highly japanned in black. The front cover is of polished brass. Provision is made to keep all dust out of the instrument. The oil is carried in the cup forming the rear portion of the body. The cover to this portion is removable, affording easy inspection and filling of cup with oil. The cross-section view of this cup shows the level of the oil. The necessary opening in the marble, through which the body of the instrument is inserted in erection, is completely covered by the ornamental front case.

The ammeter is identical in general appearance with the wattmeter and voltmeter, but the principle employed is somewhat different. In instruments up to 100 amperes capacity, the entire current of the circuit is sent through the instrument coil. Above 100 amperes use is made of a series transformer, the primary of which is cut in on the bus bar.

In the voltmeter movement use is made of the dynamometer principle. The scale, being one of 67 degrees arc, is almost absolutely uniform throughout the range. Scales can be plotted to any value desired, from zero to the maximum called for, or from any specific point to the maximum. The maximum pressure of operation is 150 volts. Above that point step-down transformers are furnished. An index is provided which is turned to any point desired by means of a knurled thumbscrew on the rear. The series resistance coil is carried in a small self-ventilating cup, mounted immediately below the body.

In the wattmeter the dynamometer principle is again employed. The pressure coil is connected to the 100-volt ends of a step-down transformer. The series coil, for circuits of 25 amperes, takes the entire line



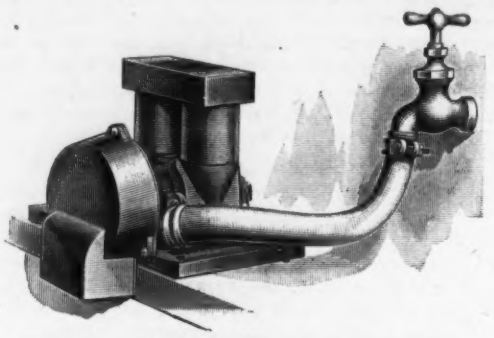
Vertical Section of Meter Showing Damping Vanes.

current. Above that amount a series transformer, identical with that used for ammeters, is employed. Station indicating wattmeters are a novelty in the market, this company being the first to advocate and build them for general station work. It is sometimes as essential that a station man know his engine or turbine load as that he know his dynamo load, and it is to meet just this need that the wattmeter line has been designed. These wattmeters are of uniform scale, sensitive, dead beat and absolutely reliable at any and all loads.

Small Scientific Electrical Machinery.

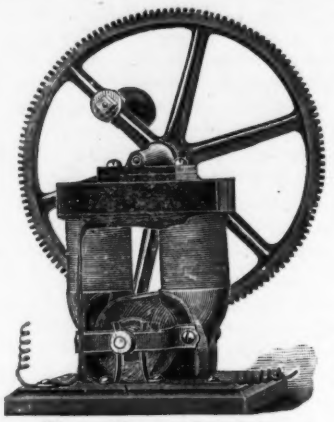
The accompanying illustrations show some of the scientific electrical toys made by the Carlisle & Finch Company, Cincinnati, Ohio. One of these machines is a hand-power dynamo driven by a large multiplying gear. The dynamo is of the regular two-pole type with massive fields similar to Edison machines, fitted with tool steel shaft and babbitt bearings. It can be used to light a 10-cp, 10-volt incandescent lamp, or furnish current for electrical toys or experiments. Among other things it will show the decomposition of water, electroplate metals, fire-blasting fuses, etc. The weight of this dynamo packed in its case is 16 1-2 pounds. The dynamo is also furnished, provided with a pulley to be run by a belt.

Another instrument which can be used for various purposes is the small direct-connected water wheel and dynamo shown in the illustration. Wherever water power at a pressure of 40 pounds or more is available, this dynamo makes an almost ideal source of small-power electric currents. It can be attached to any faucet by means of a rubber hose and clamps which are furnished with it. With 50 pounds pressure an output



Dynamo and Water-Wheel Combination.

of one ampere at 10 volts is obtained. With greater pressure a larger output can be obtained. It is made with either a series or a shunt winding, the series winding being useful for running small motors, or any such



Hand Power Dynamo.

work, the shunt winding being necessary when the dynamo is used to recharge storage batteries.

Among other experimental and toy apparatus made by this company are miniature electric railway outfits. They are made in several sizes and styles. The track and cross ties and driving batteries are provided as part of the equipment. The current is supplied to the cars through the rails.

A Tachometer of Mathematical Accuracy.

An instrument which is of interest to electrical engineers is shown in the accompanying illustration. It is a tachometer, and is in use at the engine building works of the Ball & Wood Company, Elizabethport, N. J., where it was designed. Its particular interest to electrical engineers depends upon the fact that it indicates changes of engine speed with mathematical precision and also on the fact that it is an electrically operated device. Its principle is very simple.

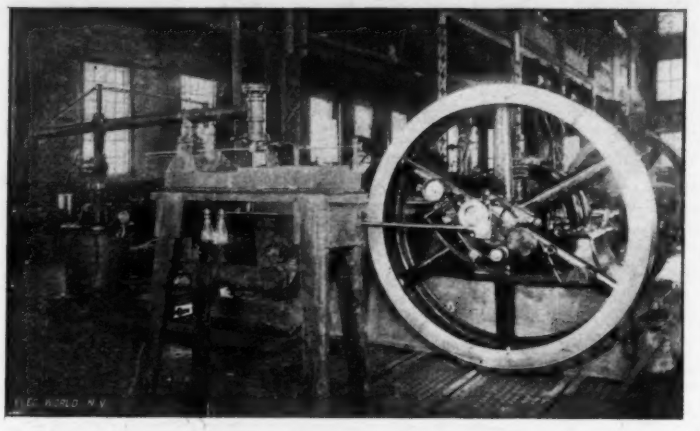
The machine consists fundamentally of a horizontal steel arm about 4 feet long, rigidly fastened at one end and capable of vibration in a vertical plane at the other end. This free end carries a strip of sheet iron in which is cut a narrow slot or window about 4 inches long and 1-16 of an inch high. A similar window is cut in the fixed plate of iron nearby. When the steel reed is vibrated, the movable strip of sheet iron cuts off the light from the stationary window except at a very brief instant when the movable window is immediately in front of the fixed slot. By placing the eye close to this fixed slot and looking through, an intermittent series of flashes is obtained. In practice the steel bar is kept in vibration by a horseshoe magnet which is energized through a make-and-break contact on the bar itself. This gives a steady vibration, the period of which can be adjusted by sliding a weight along the vibrating reed. The method of using the instrument is to set it up beside the fly-wheel of an engine and adjust it so that its vibrations keep time with the passing of the spokes of the fly-wheel. On sighting through the slots, if the synchronism is perfect, the spokes of the fly-wheel appear to be standing still. If then the speed of the engine falls off slightly, the spokes will appear to move backwards; if, on the contrary, the speed increases, the spokes will appear to move forward slowly. The instrument is always adjusted to the speed of the engine when running with no load, and the test is made by applying a load with an improvised prony brake, as shown in the illustration. Indicator cards of the engine are taken to show the magnitude of the load. The results with the governor are quite surprising.

A representative of The Electrical World made tests on the 150-hp tandem-compound horizontal engine shown in the figure. When the governor was correctly adjusted perfect synchronism was maintained

from no load to the full-rated load of the engine. The spoke, which was seen through the slot, appeared to swing slowly like a pendulum from side to side, the only effect of a change of load being a disturbance of the regularity of this swing.

The commonly accepted idea with regard to engine governors has always been that a truly isochronous governor would tend to hunt or pump badly, but this governor showed the falsity of this notion. The maximum change of instantaneous speed of the engine was easily calculated from the velocity of this vibration. In this particular test it was less than one-third of 1 per cent.

The tachometer need not necessarily be synchronized with the rotations of the engine. The only requirement is that the number of the vibrations



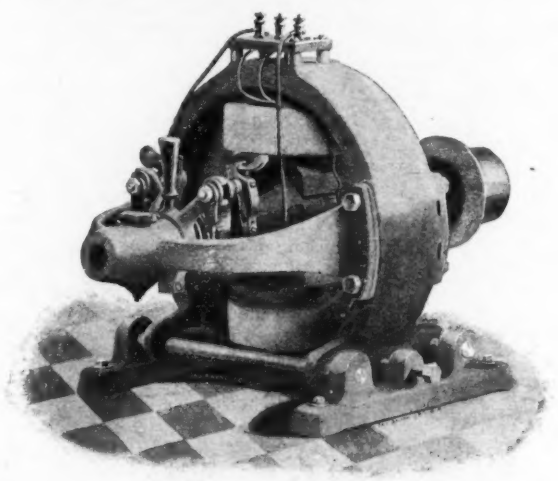
TACHOMETER IN USE TESTING 150-HP ENGINE.

of the tachometer per minute shall be an even divisor of the number of rotations of the flywheel times the number of spokes. By setting the tachometer in accordance with this requirement, and out of synchronism with the engine rotations, the variations of speed during each stroke due to the push of the piston are shown.

This tachometer is a very simple device, requiring no great care or precision in its construction. It can be made up in any shop as it was in the Ball & Wood works.

A New Commercial Motor.

The Commercial Electric Company, Indianapolis, Ind., has designed a new motor and dynamo to supply the demand for an efficient high-grade machine at moderate cost for small isolated-lighting plants or for driving light machines, such as ventilating fans and ice-cream freezers. They are also applicable for use in small machine shops. The motor is exceedingly



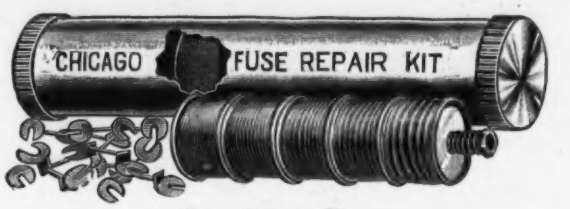
A NEW MOTOR OR DYNAMO.

compact in construction and convenient to install on account of the novel method of mounting. This latter feature consists in providing a pair of rods attached to substantial skids, on which the frame of the motor slides and is adjusted by means of a screw, thus providing a ready means for tightening the belt. The bearings may be inverted so that the motor may be suspended from the ceiling if desired. This method reduces the expense of installation. No platform is required for the machine, and a neater and more substantial appearance is thus given to the installation.

The magnet frame of these machines is of cast steel, with circular cores for the field coils. The pole shoes or extensions are of such size and shape as to give the best distribution of magnetism and secure the greatest possible efficiency of the magnetic circuit. The bearings are heavy, self-oiling, and lined with phosphor-bronze sleeves. The commutator is large and made of the best tempered copper. The carbon brush holder is of simple design and easy of adjustment, and the wear of the working parts and the attention required are reduced to a minimum as a result of these various features of design and construction.

A Handy Fuse Repair Outfit.

The Chicago Fuse Repair Kit, illustrated herewith, has been placed upon the market by the Chicago Fuse Wire & Manufacturing Company, Chicago and New York. It is substantially made of brass tubing, finely nickel plated, with screw caps, and with a bottom placed about one-third the distance from one end. In the short end are placed fuse links, assorted as may be desired. The long end accommodates the magazine containing



FUSE REPAIR KIT.

five sizes of fuse wire, each on a separate spool, and which may be changed simply by removing a spring key at one end. The repair kit entire, loaded, weighs one pound. The benefits to the lineman and repair man of this holder will be apparent at once, as it enables him to carry small amounts of a number of different sizes of fuse wire; also an assortment of fuse links, and all contained in a receptacle which is at once convenient and light, and which prevents the fuses from becoming damaged when thrown together with tools, etc., in the ordinary tool bag. The company expects to obtain a patent on this handy outfit.

A Telephone of New Design.

The Cosmo Electric Company, 30 West Randolph Street, Chicago, Ill., is manufacturing a telephone which, it is stated, will signal and talk long distances without the use of a generator. The batteries which are used in other 'phones for talking purposes only are used in this instrument for both signalling and talking.

By the use of this instrument special polarized bells may be rung through a line with a resistance of from 1000 to 1500 ohms, using for the

COSMO TELEPHONE.

HARMONIC TELEPHONE.

purpose two Leclanché cells. There are few circuits in any of the larger cities that measure 1000 ohms, and this instrument therefore would seem to promise satisfaction in practical use. In this telephone the expensive generator is eliminated. The Cosmo Company has also another 'phone which not only eliminates the generator but also the polarized bell, in which the signal consists of an harmonic sound. With this instrument it is possible to signal or call up at greater distances than bells can be rung with the standard generator now in use. The doing away with the generator and polarized bell reduces the cost of construction to a large extent.

The company is also manufacturing what it calls the long-distance magneto, using the same harmonic signal.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, September 27, 1897.

ELECTRIC STOCKS.—There was a general downward tendency in these securities last week, and in all instances where changes are recorded lower prices are given. Edison Illuminating of New York receded 2 points, as compared with the previous quotation, and Edison Illuminating of Brooklyn lost the same amount. Electric Storage Battery, both common and preferred, is fractionally lower, and General Electric is on the minus side of the market to the extent of about 3 points on the common stock and 2 on the preferred. Westinghouse, both common and preferred, is lower. The sales of General Electric for the week amounted to 39,154 shares, the net loss in price being 3¼ points. The highest figure reached was 40½, and the lowest 35⅞, closing at 37.

TELEGRAPH AND TELEPHONE.—American Bell is considerably lower in price, and Western Union receded nearly 4¼ points. The total number of shares of Western Union sold during the week was 62,580. The highest point reached was 95½, and the lowest 90¾, at which figure it closed.

ELECTRIC TRACTIONS.—This class of securities was more or less neglected, and prices are, for the most part, practically unchanged. Columbus Street Railway stock advanced fractionally on scattering sales. Worcester Traction continued scarce and in good demand. The directors have declared the regular semi-annual dividend of 4 per cent. on the preferred stock. The North Shore directors have also declared a dividend of a like amount. Brooklyn traction stock continued quiet, with the exception of Brooklyn Rapid Transit, of which considerable changed hands. Brooklyn Rapid Transit closed with a net loss of 2 points. The only stock in the railway list which shows an advance was North Shore Traction, which is 1 point higher than it was at the close of the week previous.

	Par.	Bid.	Asked.
ELECTRICAL STOCKS.			
Chicago Edison Company	100	126	..
Edison Electric Ill., New York	100	129	130
Edison Electric Ill., Brooklyn	100	..	112
Edison Electric Ill., Boston	100	147	148
Edison Electric Ill , Philadelphia	100	..	..
Edison Ore Milling	100	7½	10
Electric Storage Co., Philadelphia	100	29½	29¾
Electric Storage, pref	100	31½	32
General Electric	100	37¼	37⅜
General Electric, pref.	100	85	88
Westinghouse Consolidated, com	50	24	..
Westinghouse Consolidated, pref	50	54	56
BONDS.			
Edison Electric Ill., New York, con. 5s	105	112¾	..
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	100½	..
TELEGRAPH AND TELEPHONE.			
American Bell Telephone	100	267	269
American District Telegraph	100	..	30
American Telegraph and Cable	100	91	94
Central and South American Telegraph	100	124	127
Commercial Cables	100	175	..
Erie Telephone	100	74½	..
New England Telephone	100	133	..
Postal Telegraph Cable	100	99	101
Western Union Telegraph	100	90¾	91
ELECTRIC TRACTION STOCKS.			
Baltimore Traction	25	18¾	19
Brooklyn Rapid Transit	..	34	34½
Brooklyn Traction	100	..	14
Brooklyn Traction pref	100	46	48
Buffalo Street Railway	100	76	79
Cleveland Electric Railway	100		..
Columbus Street Railway	100	42	44
Hestonville	100	49	49¾
Hestonville, pref	..	..	62½
New Orleans Traction	100	6	8
New Orleans Traction, pref	100	25	28
North Shore Traction	100	19	21
North Shore Traction, pref	100	80	83
Rochester Street Railway	..	18	20
Steinway Railway	..	45	50
Union Railway (Huckleberry)	..	110	..
Union Traction, rcts $10 pd	..	12¾	13
West End, Boston	100	95	96
West End, Boston, pref	100	102½	..
Worcester Traction	100	16	18
Worcester Traction, pref	100	90	93
BONDS.			
Brooklyn Rapid Transit 5s, 1945	100	96	..
*Buffalo Street Railway 1st con. 5s	100	109	111
Cleveland Electric Railway 1st mtge., 5s	100	102	104
*Columbus Street Railway 1st 5s	100	95	97
Rochester Street Railway 1st 5s	100	90	..
Union Railway (Huckleberry) 1st mtge. 5s	..	107	111
*Westchester Electric 1st mtge. 5s	100	100	108

*With accrued interest.

THE CAPITAL STOCK OF THE LAPORTE ELECTRIC LIGHT COMPANY, Laporte, Ind., has been increased from $50,000 to $75,000.

THE NORTH SHORE TRACTION COMPANY reports gross earnings for August of $177,394, an increase of $1831, as compared with the same month of last year, and net $100,800, an increase of $3763.

THE COLUMBUS STREET RAILWAY COMPANY reports gross earnings for August of $52,365, a decrease of $1156, as compared with the same month of last year, and net $26,007, a decrease of $775.

THE CONSOLIDATED TRACTION COMPANY, of New Jersey, in its statement for the eight months ending August 31, shows a surplus, over all charges, of $117,441, against $34,896, for the corresponding period of 1896.

THE ST. LAWRENCE POWER COMPANY, which is developing the Massena (N. Y.) water power, has certified to the Secretary of State at Albany that its capital stock has been increased from $200,000 to $6,000,000. Half of this capital is to be preferred stock, entitled to 7 per cent. dividend. The principal office of the company is at 40 Wall Street, New York City.

THE CINCINNATI EDISON ELECTRIC LIGHT COMPANY has given a trust mortgage to the Central Trust Company, of New York, to secure an issue of bonds of $2,000,000. The bonds carry 5 per cent. interest from June 1, 1897, and are payable twenty years thereafter. The purpose of issuing these bonds is to cancel two mortgages, made to the Farmers' Loan & Trust Company of New York; one for $600,000, and the other for $225,000. The mortgage covers everything belonging to the Edison Company, including the franchise, personal and real estate.

ANNUAL REPORT.—The report of the Metropolitan Street Railway Company of New York City for the year ending June 30, shows the following results: Gross earnings, $8,888,804; operating expenses, $4,810,235; net earnings, $4,078,569; other income, $547,529; fixed charges, $3,186,975; net income, $1,439,122; 4 per cent. dividend declared on $30,000,000, amounting to $1,200,000; total surplus, $1,332,488; cash on hand, $295,013; number of passengers carried, including transfers, 234,705,704; transfers issued, 56,929,611. The net earnings of the company for the year were increased by $98,690, as the result of interest on investments by the Metropolitan Street Railway Company, but formerly paid into the treasury of the Metropolitan Traction.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, September 30, 1897.

THE RAILROAD COMMITTEE of the Board of Aldermen has made a report in favor of the Third Avenue Railroad Company's application for a re-grant of the Kingsbridge Road franchise. The grant is not made directly to the Third Avenue Road, but is made in the name of the Boulevard line, which recently came into possession of the Third Avenue Company. The franchise is to be sold at public auction.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.—The first meeting of the American Institute for the season of 1897-8 was held on the evening of September 29. There were no papers read, but the new National Electrical Code, issued by the National Conference on Standard Electrical Rules, was brought up for approval. After considerable discussion it was approved, with a request that certain of the rules be amended at the first favorable opportunity.

EXPORTS OF ELECTRICAL APPARATUS.—It is reported that an engineering firm in the Havemeyer Building, this city, has ready for shipment to Buenos Ayres, Argentine, for the account of a prominent export house on Broad Street, four 600-hp engines for the driving of electrical machinery. The engineering firm making this shipment states that it is doing as much work for export as for the home trade, and among some of the orders that it has at hand are two from England, one from South Africa, one from Java, one from Japan and one from Mexico. They are all for large size engines.

VISITING ENGINEERS.—About 200 members of the Western Society of Engineers last week made an excursion from Chicago to New York by way of Niagara Falls and South Bethlehem, Pa. They attended the opening of the new bridge at Niagara Falls on September 24, and from there went to South Bethlehem, Pa., over the Lehigh Valley Road. At South Bethlehem the visitors were entertained by the Bethlehem Iron Company, and the company's plant was inspected. The party arrived in this city on Saturday, and most of the members returned home on Sunday morning. Among the visitors were Messrs. B. J. Arnold, of Chicago; J. C. McMynn, Chicago; H. R. Abbott, Chicago, and J. M. Strasser, Lagrange, Ill.

NEW TROLLEY CARS FOR BROOKLYN.—The Brooklyn Heights Railroad Company has contracted for sixty new trolley cars, which are now in course of construction. They will be placed on the various lines controlled by the company and it is expected that all of them will be put into use about the 15th of October. Forty of them are being built at St. Louis and twenty in Philadelphia. They are of the eight-wheel pattern, each car having a 25-foot body and measuring 35 feet over all. All the windows are stationary, as the cars are intended for winter use only. The ventilation will be accomplished through the top of the car. The immovable windows will prevent the fresh air fiends from opening them in cold weather, thus causing discomfort to other passengers.

NEW BRANCH OF THE Y. M. C. A.—On Monday evening, Oct. 4, the new West Side branch of the Young Men's Christian Association, at 318 West Fifty-seventh Street, this city, will be opened for the inspection of the public, and appropriate exercises will be held on the occasion. Among the subjects taught at this new branch will be electrical engineering, bookkeeping, arithmetic, penmanship, commercial law, mechanical, architectural and industrial drawing, etc. This association is doing excellent work in affording opportunities and advantages to young men who are desirious of bettering their condition in life. The West Side branch is said to be one of the largest and best equipped of the Association's buildings in the country. D. E. Yarnell, M. D., is secretary.

THE AMSTERDAM LIGHT, HEAT & POWER COMPANY.—The apparatus in the station of the Amsterdam Light, Heat & Power Company on the Brooklyn water front at South Ninth Street was started up for the first time on the evening of September 28. This power station is an old one, formerly used by the State Electric Light Company until some three years ago, since which time it has been idle. The station is now fitted with two 125-light Fort Wayne series-arc machines, and two 3000-light Wood alternators; two 300-horse-power Noyes engines and Abendroth & Root boilers. A series of extensive mains has been laid in part underground and in part suspended from the elevated railroad structure. Contracts have been signed, which will load the station to its full capacity after October 1. The company is just closing the negotiations for a site in the neighborhood, on which it will erect a 5000-hp station.

IMPORTANT FOREIGN RAILWAY CONTRACTS.—The British Thomson-Houston Company, of London, through its representative, Mr. A. K. Baylor, has just closed an important electric railway contract with the companies operating the tramway systems of Dublin, Ireland, and Barcelona and Madrid, Spain. The contract for Dublin includes all steam, as well as the electric generating and motor equipment, and comprises six Allis horizontal engines of 500 horse-power each, with Babcock & Wilcox boiler-capacity necessary; six 500-kw multipolar General Electric generators for direct connection to the engines, and complete switchboard and station equipment. The car equipment will consist of 150 complete motor and series-parallel controller equipments, the motors to be mounted on Peckham trucks. This contract follows closely that made for the equipment of the Clontarf line of the Dublin tramway system, which will be opened within the next week or two. The apparatus for this was also supplied by the British Thomson-Houston Company. The contract signed for the Barcelona and Madrid roads covers five 400-kw multipolar General Electric generators, and three of 75-kw each, all to be directly connected to the engine shaft. While the three latter will be lighting generators, they will also be wound for 500 volts. This contract also includes full station equipment.

A NEW TELEPHONE.—An exhibition of the Smith-Vassar Telephone was given at the office of the Smith-Vassar Telephone Company, at 27 William Street, this city, on Thursday afternoon of this week. The new telephone has a switch, with fifty or more numbers on it, and to call a subscriber it is necessary only to put a plug in the hole corresponding to the subscriber's number and turn the switch, when he is called up instantly without disturbing the bells of any of the other subscribers on the line. Under the existing system it is necessary to have two wires from the central office for each subscriber, while the new telephone will, it is said, require only five or six wires for a hundred or more, the idea being that there will always be a wire not in use. The telephone is switched automatically to this wire, and if all are in use the mechanism is so arranged that it will make a metallic circuit on the first unused wire. It will not, however, cut in on a busy wire. It is stated that the company intends to begin the use of the telephones in small towns and villages which cannot be supplied with telephones by the Bell Company because of the great expense in maintaining the system. The new telephone dispenses with the operator, except in a city where 2000 subscribers are obtained, and where twenty sections might be necessary. One or two operators would be sufficient, however, to connect sections.

AN ELECTRICAL EXPOSITION FOR 1898.—The success of the electrical exposition at the Grand Central Palace in this city during May, 1896, has prompted several well-known gentlemen to undertake a similar enterprise to be held in 1898. A show of such magnitude and scope cannot be organized and planned in a day; a great deal of preliminary work must of necessity be done before it can be successfully carried into execution. For the purpose of conducting this undertaking a company has been organized in this city, and the articles of incorporation were filed at Albany, N. Y., on September 22. The capital stock of the company is $20,000, and the following named gentlemen are recorded as officers and directors: Cyrus O. Baker, Jr., president; Ferd. W. Roebling, vice-president, and George F. Porter, secretary and treasurer. These officers, with Leonard F. Requa, Charles A. Lieb, J. W. Godfrey and H. H. Harrison, constitute the Board of Directors. Executive Committee: C. O. Baker, Jr., Leonard F. Requa and H. H. Harrison. Mr. Marcus Nathan has been selected as general manager. This practically insures a first-class exhibition. The new electrical inventions and improvements developed since the last show will be an important factor. The interest and co-operation of many manufacturers already assured will count for much toward making this a more complete demonstration of all the applications of electricity and its branches than was possible in the first exhibition in 1896. The success of the last show in the way of bringing trade to exhibitors led to a very general demand that another exhibition be held. Although it has not yet been definitely settled where and at what time of the year the show will be held, there is a strong probability of the selection of Madison Square Garden as the place. The Grand Central Palace is not so centrally located, and while it is a possible selection the sentiment seems to be more in favor of holding the exhibition at Madison Square Garden, which offers greater advantages for a show of this character. It is thought that the exhibition will be held during April or May.

BUFFALO AND NIAGARA FALLS NOTES.

BUFFALO, N. Y., September 27, 1897.

FIRE.—On September 22, the store of J. C. Stearns & Co., manufacturers and dealers in electrical appliances at 255-257 Pearl Street, Buffalo, was visited by fire. The damage is upward of $500.

THE AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION, which held its annual meeting in Harrisburg, Pa., last week, voted to hold its next annual convention in Buffalo. Dr. Charles D. Dickinson, of Toronto, Ont., was elected president of the association for the ensuing year, and Dr. Henry Gerin, of Auburn, N. Y., secretary.

EXTENSION OF POWER HOUSE.—The addition to the power house of the Hydraulic Power & Manufacturing Company at Niagara Falls will be sufficiently advanced to receive the new electrical machinery about February next. On account of the location of the building at the bottom of the gorge, below the Falls, the work goes on slowly of necessity.

OPENING OF THE NEW BRIDGE.—The great steel arch bridge, which was built to take the place of the suspension railway bridge at Niagara Falls, was formally opened on September 23, amid imposing ceremonies. A very large crowd was present to witness the event. Mayor Cole, of Niagara Falls, Ont., and Mayor Hastings, of Niagara Falls, N. Y., met at the centre of the bridge and shook hands, which event constituted part of the ceremonial exercises. Electric cars will run over the bridge as soon as proper arrangements can be made for customs examinations.

FRANCHISE GRANTED.—North Tonawanda has granted a franchise to Mr. George P. Smith to extend his trolley line from Buffalo and Tonawanda to Niagara Falls, and the town of La Salle will hold a meeting this week to take up the subject and give it proper consideration. Mr. Smith promises to build a double-track road and enter Niagara Falls without crossing any steam road at grade. He also proposes to change the route between Buffalo and Tonawanda to the river bank, which will place it in line with the Gorge road as a scenic road. At present all the river scenery between Niagara Falls and Buffalo is lost to both steam and trolley travel.

THE GREAT NORTHERN GRAIN ELEVATOR, which was referred to in these notes in the last issue of THE ELECTRICAL WORLD, has been finished. The power for the operation of this elevator is furnished by seventeen motors of various sizes, placed mostly on the top of the building. The aggregate capacity of these motors is 997 horse-power. For the present the current will be taken from the Elk Street station of the General Electric Company, in this city, but after the completion of the new Niagara power line, power will be obtained direct from the Falls. It is promised that this new line will be finished in October. The use of electric power in the elevator makes it possible to exclude all combustible material, with an almost absolute certainty of escape from fires. All cars that come in to be loaded will be moved by electric motors, so as to eliminate the danger of fire from locomotive sparks.

PITTSBURG NOTES.

PITTSBURG, Pa., September 27, 1897.

DIVIDEND DECLARED.—The Westinghouse Electric & Manufacturing Company has declared a quarterly dividend of 1¾ per cent. on the preferred stock, payable on October 1. Transfer books close September 27 and reopen October 2.

ELECTRIC LIGHT BONDS ISSUED.—The Borough of Coraopolis, a suburb of Pittsburg, has issued bonds to the amount of $6000 for the purpose of installing an electric-light plant. The plant will be operated in connection with the water works now owned by the borough. It is the intention to purchase at present apparatus for incandescent lights only, but an arc machine may be added in the future.

PROGRESS OF UNDERGROUND WORK.—The work of freeing the streets from overhead wires has been pushed forward this summer with great vigor. The conduit work is nearly completed, and during the last few weeks practically all of the wires and many of the poles have been removed from Wood Street, Fourth Avenue and Smithfield Street. The improvement in the appearance of these thoroughfares is very noticeable. In a few months, apparently, the business portion of the city will have few wires in sight, save those maintained by the various traction companies. The feed wires of these companies, for some reason not publicly explained, are exempt from the provisions of the ordinance requiring wires to be placed underground.

CHICAGO NOTES.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., Sept. 27, 1897.

THE EGAN ELECTRIC COMPANY, of this city, has changed its name to Graham Electric Company.

MR. GEORGE PATTERSON has just been appointed Chicago and Western representative for the Gordon-Burnham Battery Company, New York, and Medbery switches and overhead appliances, manufactured by the Fiberite Company, Mechanicville, N. Y. Mr. Patterson's office is at No. 1114 Marquette Building, Chicago.

THE CICERO TOWN BOARD is likely, it is said, to allow the Suburban Electric Railway Company until December next to complete its new link on Twenty-second Street. The ordinance stipulated that the line should be fin-

ished next month, but it is the desire of the members of the board that a boulevard should be constructed on both sides of the track, and they are anxious to come to an agreement with the company whereby the latter shall bear a portion of the cost of the suggested improvement.

OVERHEAD-WIRE QUESTION.—Mayor Harrison has informed the Western Union, Postal, and American District Telegraph Companies that all of their overhead wires in the downtown district must be cabled at once. There are 4000 such wires, with a total length of 90 miles, now running over the buildings and streets in the heart of the city, and the mayor told the representatives of the companies that they must either put the wires under ground or cable them, so that not more than one cable shall cross any street or alley in any one block. The companies have decided to cable the wires.

CHICAGO ELECTRICAL ASSOCIATION.—The programme of the Chicago Electrical Association has been issued for the season of 1897-98. The following papers will be read on the dates given: October 1, "Economy in Electric Car Control," by James R. Cravath; October 15, "Evolution of the Isolated Electric Plant," by Harold Almert; November 5, "The Safe Current Capacity of Electrical Conductors," by C. H. Sewall; November 19, "Daily Mathematical Conveniences," S. G. McMeen; December 3, "Heavy Electric Traction," Cloyd Marshall; December 17, "Electricity in Ship Building," by C. C. Mattison; January 7, "Electrical Shop Transmission," H. G. Dimmick; January 21, "The Art of Constructing Telephone Apparatus," Henry P. Clausen.

THE COMMONWEALTH ELECTRIC COMPANY has filed an acceptance of its ordinance passed by the Council July 21 last. The formal acceptance was accompanied by a bond for $50,000, which is required under the terms of the ordinance. The ordinance was regarded as a purely speculative measure, which was intended to be sold to the Edison Company, but that company, it is stated, refused to purchase the franchise. Later on several attempts were made to dispose of the ordinance. Several offers of $100,000 were made for the franchise, it is said, but these were not approved by the Aldermen, who demanded a higher price. The ordinance gives the Commonwealth Electric Company the right to put in an electric plant for the purpose of furnishing light, heat, power and the transmission of sounds and signals over the entire system.

Milwaukee Notes.

Milwaukee, Wis., September 27, 1897.

MESSRS. PETERMAN & WALBER are busy with general work. One of the features at the Milwaukee Exposition is their electrical display.

THE JULIUS ANDRAE & SONS COMPANY has the following isolated plant contracts: Two 50-kw Northern dynamos, direct connected to Ball & Wood engines, for the Milwaukee Medical College and School of Dentistry, and a 300-light plant at St. Charles, Ill., for the Crown Manufacturing Company. The same company has secured the contract for the wiring of the State Historical Library and Museum Building, at Madison, Wis. Iron-armored conduit will be used in this installation. It has also secured the wiring contract for the Home for Dependent Children at Wauwatosa. The Andrae Company has just completed the 500-light city plant at Cedarburg, Wis.

St. Louis Notes.

St. Louis, Mo., September 27, 1897.

NO MUNICIPAL PLANT.—Belleville will not have a municipal electric-light plant for at least three years. Last Monday a proposition was received from the electric-light company to furnish arc lights for $75 each on a contract extending over three years, and the City Council accepted the proposition.

THE NATIONAL CONDUIT AND SIGNAL COMPANY filed articles of incorporation in the Recorder's office, September 24, with a paid up capital of $250,000. The incorporators are H. H. McElhiney, Benjamin Eisman, Benjamin C. Seaton, Denister Wishart and Andrew Sullivan. The company proposes to do a general electrical business.

ELECTRICITY IN THE TUNNEL.—It is reported that the St. Louis Terminal Railway Association has decided to use electricity as the motive power through the tunnel, which runs from the Eads Bridge, under the streets to the Eighth Street railroad yards. It is proposed to have electric locomotives, thus doing away with the smoke that always has been such an objectionable feature. It is also said that the tunnel, which is now so dark, will be lighted by electricity.

THE KINLOCH TELEPHONE COMPANY.—Work on the Kinloch telephone system is being rapidly pushed. The company finished laying its conduits July 6, and is now engaged in setting poles and strnging wires. After this, wiring of buildings and placing of instruments will be commenced. The company has 6500 subscribers so far, and will be ready for business by August 1, 1898. In East St. Louis the company is making rapid progress, and will be put in operation about the same time. Several hundred subscribers have been obtained.

THE ST. LOUIS & BELLEVILLE ELECTRIC RAILROAD.—Before the last of October grading for the roadbed will be started, and the road finished and in running order by next July. The road will be a double-track one, and the rate of speed will be not less than 40 miles an hour. To begin with, a system of transfers will be used in carrying passengers across the bridge, but later on arrangements will be made to run the cars direct to Third Street and Washington Avenue, this city. Mr. Sutter, secretary and treasurer of the company, has returned from the East, where he has been inspecting long-distance electric roads.

AXES WERE USED.—The officers of the St. Clair County Turnpike Association cut down a number of the poles and the wires of the Bell Telephone Company, between Belleville and East St. Louis, last Saturday. For several months there has been trouble between the parties. Heretofore the Telephone Company has been using small poles, but a short time ago tall poles were put in, and the Turnpike Company objected. It said if the tall poles remained they would have to pay rental, and the Telephone Company refused to pay. The Turnpike Company gave it sixty days to remove the poles, or they would be cut down. This the Turnpike Company did Saturday. It is expected the courts will have to settle the matter.

Pacific Coast Notes.

San Francisco, Cal., Sept. 15, 1897.

PROF. F. A. C. PERRINE, of the Electrical Engineering Department, Stanford University, has returned from an Eastern tour and resumed his duties at the big school.

THE SIERRA TELEGRAPH COMPANY has been incorporated with a capital stock of $12,400. The proposed line will connect Knights Ferry, La Grange and Centreville with Modesto, Cal.

MR. A. M. HUNT, of Messrs. Hasson & Hunt, consulting engineers, is making an examination of the water-power prospects on the Little Sur River for a company which has had an electric-transmission project under consideration for some time. The above named firm is also preparing plans for underground-conduit systems for the San Gabriel Power Company, controlled by Mr. Balch, and for the Los Angeles Railway Company, to comply with the requirements of the Los Angeles City Council.

THE PACIFIC CABLE.—A party of high officials connected with the management of the Mackay-Bennett Commercial Cables recently arrived in this city from British Columbia, accompanied by Superintendent L. W. Storror, of the Postal Telegraph Cable Company. Included in the party were President John W. Mackay, General Manager George G. Ward, and Messrs. Dey and Dickinson. The last named gentleman has charge of the cable-landing station in Nova Scotia. Mr. Storror disclaimed that the party had any designs on the Pacific Ocean or the Yukon, though Pacific cable and Alaska rumors followed them persistently on their tour of inspection.

ELECTRICAL LABORATORY AT THE CALIFORNIA UNIVERSITY.—Work is about to be commenced on the electrical laboratory of the medical school of the University of California. This school will be one of the "affiliated colleges," in which will be comprised the leading medical colleges of California, and for the use of which a stone building is being erected near Golden Gate Park, San Francisco. The electrical laboratory apparatus has been selected by Dr. Philip Mills Jones, who holds the lectureship on electrophysics and electro-therapeutics in the University of California. The total cost of the electric equipment will exceed $10,000. A 30,000-ohm eight-coil Thomson galvanometer will be the most important item in the large orders, which will be filed in Europe. Messrs. Nalder Bros., of London, are now filling an order. It is the intention, with the above beginning, to have in California a laboratory that will not be excelled by any of its kind in the United States. A very complete equipment for X-ray and "skiagraphic" work will be a prominent feature.

English Notes.

(From Our Own Correspondent.)

London, September 15, 1897.

THE HEILMANN ELECTRIC LOCOMOTIVE.—The perfected Heilmann steam electro-locomotive has at last begun its trials. The generating plant consists of two 1600-ampere Gramme machines, driven by Willans engines, and it is said that a regular speed of some 72 miles an hour has been attained.

DISTRIBUTION OF ELECTRIC ENERGY FROM THE PIT'S MOUTH.—It is reported that in the important coal and iron centre of Ruhrort, in Germany, a company has been formed, composed of influential industrial firms, for the purpose of erecting a central station and distributing electric energy for lighting and power to the surrounding district.

INTER-URBAN TELEPHONY IN IRELAND.—The Post Office, having more or less completed its inter-urban network in England and Scotland, is now extending its operations to Ireland, and last week the three big towns of Southern Ireland (Dublin, Cork and Limerick) were placed in telephonic communication with each other, the distance being some 225 miles, quite a long one for this compact kingdom.

ELECTRIC TRACTION AT LIVERPOOL.—As I said in a recent letter, a considerable hubbub has been caused in Liverpool by the desire of the Tramway Committee to appoint Mr. F. S. Pearson, an American electrical engineer, as consulting engineer to the Liverpool Corporation. Mr. Pearson has now relieved the Tramway Committee from all embarrassment in connection with his disappointment by the intimation that his numerous contracts will preclude him from accepting any position under the Corporation in a consultative capacity. It has now been unanimously agreed to ask Dr. John Hopkinson to accept the post.

THE CENTRAL LONDON RAILWAY.—I hear that progress on the Central London Railway excavation work has been somewhat retarded of late, owing to the workmen who are excavating the whole of the open space in front of the Mansion House, Bank and Royal Exchange, having come in contact, as is very common when excavations are being made in the city, with large blocks of the hardest Roman cement. In the direction of Bayswater, also, the workmen have come across a tract of soil which gives forth such an unendurable stench that it is difficult to continue working. It is thought that this is due to their having come across an old plague burial ground.

ELECTRIC MOTOR CARS.—I hear that the police authorities, after having refused licenses to several other kinds of motor carriages, have, after a severe test, licensed the electric cabs of the London Electrical Cab Company. A part of the police test is to run each cab up and down the Savoy Hill in the Strand, this being the steepest gradient in London. Since the cabs have come into regular operation, journeys have been made on several occasions to and from the outskirts of London, along more or less greasy London subur-

ban roads. The cabs which are now plying for hire in and around the city and West End have been doing very well, their takings amounting to more than 150 per cent. of those of the ordinary hansom. With regard to the opposition of the London Cab Trade Council, to which I have referred in a previous letter, I may mention that this Council only numbers some fifty or sixty members, and as a set-off against this so-called "opposition," the great Cab Drivers' Union of London, numbering some 10,000 members, are said to be distinctly in favor of the new vehicle. The great transport firm of Carter, Paterson & Co. is now running several electric motor cars for its express parcel delivery service.

INSULATED PIPES FOR HOUSE WIRING.—The evolution through which Mr. Fred Bathurst's ideas have gone since his return from the United States some two or three years since is a curious instance of what may be termed the "solidifying" influence of the atmosphere of the United Kingdom. Mr. Bathurst returned from the States in the full flush of his enthusiasm for the interior conduit system, which, with its accompaniment of cheaply insulated wires, met with a complete discouragement in this country. To satisfy English fancy Mr. Bathurst then decided that inferior insulation was not a necessary component of the system, and to prevent punctures wrapped some soft brass tape round his tubes, the flexibility of which was then a great point with him. Fire insurance offices and the technical press, however, would as yet have nothing to do with him. Mr. Bathurst then evolved an ordinary gas barrel system, the pipes being lined with his impregnated paper. To this it was objected that he had lost all the flexibility claimed with his system, and had obstructed the free way of the tubes. The final evolution is cold-drawn Mannesmann steel tubes, having the same external diameter as our usual gas barrel, but which, owing to the pipes being considerably thinner and lined with a mere film of impregnated paper, have a free way equal to that of the ordinary gas barrel. Thus equipped, Mr. Bathurst finds that he is able to obtain as many orders as he can fill. In its latest evolution his so-called system of "interior conduits" is not only thoroughly workmanlike and durable, but is easily put up by an ordinary gasfitter. It has been thought out in all its details with extreme care, but it no longer bears the remotest resemblance to the "interior conduit" which he imported from the United States some three years ago; it is now a thoroughly solid job of the true British pattern.

General News.

NEW INCORPORATIONS.

THE BELLEFONTAINE ELECTRIC RAILWAY COMPANY, Bellefontaine, Ohio, has been incorporated with a capital stock of $25,000.

THE HUSTONVILLE & GREEN RIVER VALLEY TELEPHONE COMPANY, of Liberty, Ky., has filed articles of incorporation with the Secretary of State. The chief incorporator is F. B. Combust. Capital stock, $750.

THE AKRON DISTRICT TELEGRAPH COMPANY has been incorporated at Columbus, Ohio, by John W. Miller, Marvin J. Galloway, Homer A. Hine, George E. Felver, Edward D. Eckroad and James P. Loomis. Capital stock, $20,000.

THE ELECTRIC VEHICLE COMPANY, Jersey City, N. J., has filed articles of incorporation with a capital stock of $10,000,000. The incorporators are Gustave E. Kissel, of Morristown, and N. J. Phillip and L. Edward Tuck, of New York.

THE BENTON POWER TRACTION COMPANY, Sauk Rapids, Minn., has been organized with a capital stock of $50,000. The incorporators are Charles and J. B. Moffett, J. F. McGee and Wendell Hertig, of Minneapolis, and C. M. Hertig, of St. Cloud.

THE MONTEVIDEO ROLLER MILLS & ELECTRIC LIGHT COMPANY, Montevideo, Minn., has been formed with a capital stock of $45,000. The incorporators are Charles and J. C. Kittleson, of Minneapolis; O. M. Kirlin, C. A. Fosness and P. S. Norman, of Montevideo.

THE BOROUGH OF MANHATTAN ELECTRIC COMPANY, New York City, N. Y., has been incorporated, with a capital stock of $100,000. The directors are Charles A. Lieb, Hugh H. Harrison, Joseph F. Darling, Albert S. Williams, Charles P. Blancy, Robertson Honey and Edward Schmodt, of New York City.

THE ATLANTIC DISTRICT TELEGRAPH COMPANY has filed articles of incorporation at Camden, N. J. The purpose of the company is to construct and operate a telegraph system and do a general telegraph business. The incorporators are Charles C. Adams, George G. Jewil, of Philadelphia, and James Donally, of Camden. Capital stock, $10,000.

THE TELEGRAPH AND TELEPHONE.

OKLAHOMA CITY, OKLA.—A telephone line is being built between this city and El Reno.

BUSHNELL, ILL.—The Fulton County Telephone Company is after a franchise in this place.

KANSAS CITY, MO.—The long-distance telephone between this city and Chicago has been tested and works very satisfactorily.

CHATTANOOGA, TENN.—The new telephone line between Chattanooga and Benton is now in operation, and is giving complete satisfaction.

GLASGOW, MO.—A franchise has been granted to N. W. Wickes and Henry Schnell, of Glasgow, to build and operate a telephone exchange in this place.

CANTON, ILL.—The Central Union Telephone Company has completed its line between Canton and Cuba, and is now at work constructing a line between Cuba and Smithfield.

FAYETTE, MO.—A franchise has been granted to J. D. Perry, of St. Louis, and C. E. Betts, of Fayette, to build and operate a telephone exchange in this city. Work on the system has already been commenced.

SOUTH BEND, IND.—The Citizens Telephone Company has so many calls for new instruments that it is preparing to considerably enlarge its facilities. The company is giving good service, is paying its way, and making money for its stockholders.

CHAGRIN FALLS, OHIO.—Bainbridge Township farmers have organized a telephone company, and are putting up a line which will connect all the prominent farmers' residences of that township with Chagrin Falls. It will also give the township connection with every other township in Geauga County.

JACKSON, MICH.—A telephone franchise has been granted to Messrs. N. S. Potter, Albert Stiles, S. B. Collins and A. J. Peak to establish a telephone system in this city. This is the fifth franchise of a like character granted by the Council within the past two years. All the persons above named are residents of Jackson, and have ample means for carrying out the new project. The rates are fixed at $18 for residence and $24 for business 'phones.

ELECTRIC LIGHT AND POWER.

ATHENS, ALA.—This place will have electric light. This was decided at a meeting of the City Council September 17.

WYANDOTTE, MICH.—It has been decided to bond the city in the sum of $8000 to complete the city electric-light plant.

CLEARFIELD, PA.—The electric-light plant at this place was destroyed by fire on the night of September 17. The loss, which is large, is covered by insurance.

NEW YORK, N. Y.—The New York & Staten Island Electric Company has received a franchise to light the roads in the entire town of Westfield outside of the village of Tottenville, S. I.

LAGRANGE, MO.—An election will be held here on October 19 to vote upon the proposition to issue $6000 worth of bonds for the purpose of establishing an electric-light plant in this place.

FREEPORT, L. I., N. Y.—The taxpayers have voted to establish a lighting system to be owned by the city. The trustees are of the opinion that $15,000 will procure a first-class plant, and that it will take thirty-five arc lights to illuminate the village.

GAS CITY, IND.—The Council is considering the proposition for water works and electric light. A special meeting will be held, at which some definite action will be taken. It is almost an assured fact that one or both plants will be put in this fall.

SIGOURNEY, IA.—The Sigourney Light & Power Company has a force of men at work rebuilding the lines of its system. The plant was installed seven years ago by the Hawkeye Electric Company, of Davenport, Ia., from whom it was purchased two years ago by the present company.

UNION, S. C.—Sealed proposals for constructing an electric-lighting plant will be received by the Commissioners of Public Works until October 12. A certified check for $500 must accompany bid. Specifications and further information can be obtained on application to the chairman, F. M. Farr.

LOGANSPORT, IND.—The Electric Light Committee of the Council has asked for an appropriation for additional machinery. There are connected up 10,000 incandescent lights. The capacity of the plant is 4500 incandescent lights, and if all the lights were used at once the plant would be unable to meet the demand. The receipts up to September 1, 1897, show an average of $1500 per month, a total of $18,000 per year. The expenses aggregate $11,000 a year, showing a profit of $7,000.

GRAND RAPIDS, MICH.—The Lowell Water & Light Company, the West Michigan Electric Company and the Peninsular Light, Heat & Power Company, three distinct companies, with substantially the same stockholders, whose affairs were placed in the hands of the Michigan Trust Company last spring, as trustee, will be sold at auction on October 18. The companies were organized to develop the water power of Flat River at Lowell, 20 miles east of here, to transmit electric current to this city for commercial purposes. But the financial depression prevented any capital from being put into it to make it a success. It is probable that the entire property will be bid in by a syndicate of Eastern capitalists.

THE ELECTRIC RAILWAY.

DOYLESTOWN, PA.—It is stated that there is to be a trolley line connecting Doylestown with Willow Grove very soon.

ST. JOHNSBURY, VT.—The St. Johnsbury Street Railroad Company, having made surveys, will shortly commence the construction of its road.

TRENTON, N. J.—The Trenton Passenger Railway Company has asked the Common Council for a franchise to extend its tracks out Mulberry Street.

EMMETSBURG, IA.—A member of the syndicate which recently purchased the Emmetsburg Railroad, says it is the intention to extend the road to New Midway.

NORWELL, MASS.—The directors of the Rockland & Abington Street Railway Company have petitioned the Selectmen for the right to lay tracks and operate a street railroad.

PHILADELPHIA, PA.—It is reported that another effort is to be made in Councils to have a trolley road constructed connecting the lower part of the city with the League Island Navy Yard.

LIMA, OHIO.—The City Council has granted the Lima Street Railway Company additional franchises for several streets, and the lines will be immediately extended several miles, giving employment to a large number of men.

PITTSBURG, PA.—The Glenwood & Dravosburg Electric Railway Company has been engaged in a suit with the Pennsylvania Railroad Company over the question of crossing the tracks of the latter by an overhead bridge. An opinion has been handed down allowing the Electric Railway Company to operate over the bridge.

OSHKOSH, WIS.—It is stated that the Oshkosh Street Railway Company and the Citizens' Traction Company have practically agreed on the price in the negotiations by which the plant and franchises of the former company will be transferred to the Citizens' Traction Company.

HERKIMER, N. Y.—Electric railroad projects have been launched in Herkimer County, and it now looks as if the time was not far distant when Little Falls will be connected with Utica by electric railroad. Col. Clinton Beckwith, of this village, a member of the contracting firm of Beckwith & Quackenbush, is the leading promoter in the electric project. He is president of the Little Falls & Herkimer Electric road.

CHICAGO, ILL.—It has been decided to dispose of the Englewood & Chicago Electric Street Railway at public auction on October 12. This disposition of the property is in pursuance of a decree entered in the United States Circuit Court on July 7. A reserve price of $250,000 will be the minimum offer considered, and bids must be made good by a deposit of $25,000 in cash with any of the national banks or trust companies of the city.

HARTFORD, CONN.—The incorporators of the Meriden, Southington & Compounce Electric Road have opened books for subscriptions to the capital stock, which is to be $100,000. The route that will be selected will probably be from the West Main Street terminus of the Meriden electric road to Milldale, Plantsville, Southington, Plainville and Compounce, connecting with the Bristol & Plainville Tramway, and also the Central Railway Company of New Britain. It is proposed to do away with the overhead trolley, although in what manner has not been stated.

BIRMINGHAM, ALA.—The Birmingham Railway & Electric Company, owner of the street-car system of this place, two suburban electric roads and one steam dummy line, has closed a deal for the purchase of the Birmingham, Powderly & Bessemer steam dummy line, extending from here to Bessemer, 14 miles, and a strong competitor of the electric company's road. The road will either be equipped with electricity and used as a loop in conjunction with the company's old Bessemer lines, or may be disposed of for terminal purposes to some new trunk line that may seek admission to the city.

ANDERSON, IND.—The Big Four Railway Company is turning its attention to the proposed electric railway between this city and Marion, which is being constructed by the Union Traction Company of this place. The line will parallel the steam road throughout the best territory in the Michigan Division, and it is stated that the United States Express Company will operate over the electric road. The competition for traffic between Anderson and Benton Harbor between the two concerns will be strong, and the electric company announces that it will charge less than half the rate of the steam road and run more frequent trains.

ST. PAUL, MINN.—An ordinance has passed the Assembly allowing the Twin City Rapid Transit Company to change its cable line on Fourth and Selby Avenues to an electric system. This change has been contemplated for some time, but has been delayed by a very heavy grade on the line of the road, which was considered unsafe for anything but a cable system. At the foot of the grade there is a sharp curve, and the combination has resulted in one quite serious accident under cable operation. Special safety appliances will be adopted at this grade, to be approved by the City Engineer. The appliance has not yet been decided upon, but will probably be of the nature of an auxiliary rack rail or cable system.

BALLSTON SPA, N. Y.—The Ballston Terminal Railroad has adopted electric power for traction purposes. The power house, a commodious and substantial structure, built on modern ideas, is now completed. It is fitted with Babcock & Wilcox boilers, Hamilton Corliss engines and Westinghouse electrical apparatus; the cars were made by the J. G. Brill Company, and the overhead material was supplied by Mayer & Englund, Chicago. The road bids fair to be completed before the close of this month. The passenger service will be taken care of by ordinary passenger cars hauled by electric locomotives. The bulk of the traffic, however, will be freight service, which will be handled by electric locomotives designed for this purpose. Work on the road is being rapidly pushed under the management of Mr. J. C. Stanton.

Obituary Note.

WILLIAM WOODNUTT GRISCOM the well-known electrical engineer and second vice-president of the Electric Storage Battery Company, of Philadelphia, was killed by the accidental discharge of his rifle at Governor's Island, near his new summer residence on Minniocoganshene Island, Ont. Mr. Griscom had been spending the summer at this place, and had gone out rifle shooting last Friday. In some manner his gun was accidentally discharged with fatal effect. The body was taken to the home of the deceased at Haverford, Pa., and the funeral took place on Tuesday afternoon, September 28. Mr. Griscom was born in Philadelphia in 1851, and studied at Haverford College for two years, finishing his course at the University of Pennsylvania, from which institution he was graduated in 1870. He had been in ill health in late years, and two years ago spent some time at Carlsbad in the hope of obtaining relief. It was also with this object in view that he had been spending his summers at Minnicoganashene Island, Ont. A widow and two children survive the deceased.

Trade and Industrial Notes.

THE CHERRY ELECTRIC WORKS, New York City, have just shipped a large order for their ammeters and voltmeters to be used in educational work in China.

CHANGE OF NAME.—The Westinghouse Glass Factory at Pittsburg, Pa., has been incorporated under the title of the Pittsburg Glass Company. The new concern has established its headquarters at Allegheny, Pa.

NEW BRANCH OFFICES.—Henry R. Worthington, Brooklyn, N. Y., has opened a branch office at Nos. 713-717 Perdido Street, New Orleans, La., and one in the Century Building, 317 North Ninth Street, St. Louis, Mo.

THE WARREN ELECTRIC & SPECIALTY COMPANY, Warren, Ohio, has just issued a booklet, entitled "Flim-Flam Tests versus the Test of Experience." Some facts of information are contained in the little pamphlet which will interest incandescent lamp dealers and users.

THE ZIMMERMAN SUPPLY COMPANY, 19 York Street, West, Savannah, Ga., announces its intention to carry a complete line of electrical goods, and will inaugurate this feature of the business on January 1 next. It desires to obtain catalogues from concerns interested in this line.

THE LARGEST POWER GENERATORS.—The Walker Company is making a strong mark in the electric railway business, as well as in electric lighting. It has just sold to the Brooklyn Heights Railway Company two 1600-kw generators to go in the Kent Avenue power station. These generators are said to be the largest machines of the kind ever made.

THE CHICAGO BELTING COMPANY, Chicago, is having a great rush of business, which necessitates the running of its factory night and day. As it is a month behind with its orders, it has decided to double its plant and put in new machinery throughout. It has just received an order from Paris, France, for 4000 feet of belting.

COMPLETE WATER POWER EQUIPMENT.—Messrs. James Leffel & Co., Springfield, Ohio, builders of the double-turbine water wheel, supply water power equipments complete. One such was the equipment of the Columbus, Ga., power station, which was described in the September 4 issue of The Electrical World. James Leffel & Co. designed the whole equipment and built the penstocks, supporting columns, steel beams and turbine apparatus.

EQUIPMENT OF GEAR CUTTERS.—The Carnegie Mills have recently added Eberhardt's Automatic Gear Cutters, 74 x 14 inches, for their large work, also a 30-inch for spur, bevel and worm gears for their smaller work. These machines are marvels of automatic mechanism, and possess improvements never before put upon the market. They were supplied with cutters specially adapted for automatic machines.

THE GATES IRON WORKS, Chicago, has recently closed a contract with the Cramp & Hodley Engine Works, Philadelphia, to construct the heavy work on one of their large engines, the flywheel of which weighs 61,000 pounds. This company has also closed contracts at Bay City, Mich., for two 120-hp engines, and with the City of Perry, Ia., for one 150-hp engine to be direct connected to two phase alternating Westinghouse dynamos.

MR. THOMAS S. GORDON, who, for the past eleven years, has been connected with the Chicago house of the John A. Roebling's Sons Company, resigned his position September 15, and we understand is to go into business for himself in the same line. Mr. Gordon is well known in the trade, very popular, and also pushing and energetic. He has not yet located his office, but his friends in the trade will be notified when he is ready to do business.

ELECTRIC LIGHTING SPECIALTIES.—The Dale Company, 108 Greenwich Street, New York, has issued a catalogue of its electric and combination fixtures, shades, reflectors and material for interior lighting. The catalogue is profusely illustrated with fixtures of many designs. The various specialties handled by this company are also well displayed, and all interested in this line will find it to their profit, no doubt, to obtain a copy of this catalogue.

DRY BATTERY.—The Burnley Battery & Manufacturing Company, Painesville, Ohio, reports that the demand for the well-known Burnley battery, of which it is the manufacturer, continues to increase. This battery has been on the market for ten years, and has an unquestioned reputation for general utility and durability, and it is giving excellent satisfaction. Over 150,000 were sold in less than twelve months. The original excellence of this battery is guaranteed by the present manufacturer.

THE ORIENT ELECTRICAL COMPANY, Youngstown, Ohio, is evidently one of the most successful independent incandescent lamp manufacturers. Its business is constantly improving, and its lamps, so we are informed, are giving entire satisfaction. As an independent manufacturer it is doing exceedingly well. The Orient Company recently received an order from the United States Government for incandescent lamps of its make, which order was undobutedly given on account of the excellence of these lamps and their ability to meet all requirements. The order was secured in the face of strong competition.

ROOF CONSTRUCTION.—The roof of the new Spence Library of the Union Theological Seminary, at Richmond, Va., will be of fireproof construction. The trusses will be steel, and the covering of slate, attached directly to metal supports. One end of the building is round, making a conical-shape roof, and at various points of the roof-slope are placed dormers and skylights. The peculiarity of the construction makes the ironwork very intricate in order to get the pleasing architectural appearance desired. The contract for furnishing and erecting the steel work for the roof has been given to the Berlin Iron Bridge Company, of East Berlin, Conn.

CEDAR POLES.—The Monona Cedar Company has been organized at Marinette, Wis., for the purpose of furnishing poles for electric lines right from the tree to the consumer. The company started business on October 1, with Mr. T. E. Brittingham, of Madison, Wis., as president, and J. E. Reinger, secretary. The company is well backed financially. The Brittingham & Hixson Lumber Company, of which Mr. Brittingham is a member, is one of the wealthiest concerns of its character in that part of the country. The supply of poles to consumers right from the woods is a feature which this company claims has not been attempted by any other dealer.

PURCHASE OF PATENTS.—We learn that Mr. M. T. Davidson, of Brooklyn, N. Y., manufacturer of the Davidson steam pumps and hydraulic machinery, has recently purchased all the patents of Mr. George W. Baird, Chief Engineer United States Navy, for evaporating and distilling apparatus, and is now the sole owner and manufacturer of the same. While retaining all the features that have made the Baird apparatus so well known, Mr. Davidson has added some improvements of his own, and now guarantees it to be the simplest, most efficient and most easily cleaned, while occupying the minimum space and weighing no more than any other apparatus employed for a similar purpose.

MESSRS. MARIS BROTHERS, manufacturers of traveling cranes, Philadelphia, Pa., are erecting a new machine shop to meet the demands of their increased business. The building will be 55 feet by 75 feet. Running the full length of the structure will be a 10-ton power crane, having a span of 30 feet. One side of the building will be arranged with a gallery, on which will be placed the lighter machinery. The framework of the building is of steel, and the covering of the sides and roof will be corrugated iron. Contract for the complete building has been let to the Berlin Iron Bridge Company, of East Berlin, Conn., who designed the structure, and who will furnish and erect all the material.

COMMUTATOR COMPOUND.—Gale's commutator compound has evidently become a staple article, it being regularly used by nearly every power plant and central station in the United States and Canada, and by a large number of isolated plants. Mr. Isaacs, of K. McLennan & Co., Chicago, manufacturers of this compound, expresses the opinion that the large and increasing sales of this material is not due so much to the better business conditions in general, but rather to the fact that a very much larger quantity of compound is used in the fall season beginning from September 1, than in the summer. This he believes to be the real cause of the increased sales, together with the fact that the price of the compound has been reduced to a point where smaller plants are enabled to make freer use of the article. Gale's commutator compound is claimed to be the cheapest and the only kind that absolutely prevents sparking and cutting of commutators, at the same time putting a high gloss on the commutator without gumming the brushes. A free sample of this compound will be furnished on application to K. McLennan & Co.'s office, Marquette Building, Chicago.

NEW PUMP CATALOGUE.—General Catalogue No. 23, of the Worthington pumping engines, steam pumps and hydraulic machinery, has been issued under date of August 20, 1897. The catalogue is a very complete affair, and carefully arranged and indexed. It starts with illustrations and complete data of the Worthington steam pumps, showing all the different varieties for high and low pressure, boiler feed, tank service, simple and compound and special pumps. The high-pressure plunger pumps are followed by the mine pumps, sinking pumps, marine, ballast and wrecking types. Besides these are listed air pumps, jet condensers, surface condensers, etc. Among the more novel features of interest are the Worthington self-cooling condensers, which produce a vacuum without natural supply. These condensers depend on the cooling properties of towers exposed to atmospheric influence, and can be placed on the roofs of buildings or any other place where they will not occupy valuable space. The Worthington dry vacuum system is also described and illustrated, in which the vacuum is obtained by force of gravity and the air removed by the dry vacuum pump. A complete line of electric pumps is included in this catalogue as well as Worthington combined boilers and pumps, air compressors, steam accumulators and high duty triple-expanson pumping engines.

IN NEW QUARTERS.—The Ward Leonard Electric Company has just moved into its fine new factory at Bronxville, N. Y., where it will have the most complete and efficient manufacturing facilities of every kind. The buildings of the company are located on the east bank of the Bronx River, and it would be difficult to find a factory with more pleasant surroundings. There are trains every few minutes to the Grand Central Station at Forty-second Street, New York City, there being over eighty trains per day. Bronxville is only 2 miles north of New York City, consequently the company's factory will be extremely accessible to the heart of New York City. "Nothing succeeds like success," may be truly said of the Ward Leonard Electric Company, for, notwithstanding the dull times which have prevailed since the company began business a few years ago, and notwithstanding the complete destruction of its works by fire four months ago, its business continues to grow with surprising rapidity. Perhaps the most notable fact in connection with this company is the very large foreign business it is doing, which seems to be entirely due to the merit of its goods and their low prices, as the company has never done any advertising abroad, and has never sent a representative abroad. In view of the well-known prejudice against American goods on the part of foreign engineers this is certainly most exceptional

"THE ELECTRICAL WORLD" IN HAWAII.—The letter of which the following is a copy is self-explanatory:

RIDGWAY, PA., U. S. A., September 22, 1897.

Editor THE ELECTRICAL WORLD: Dear Sir—The following letter is interesting as indicating the world-wide circulation of THE ELECTRICAL WORLD. This letter, as you will note, is dated August 18, and has just been received by us. The reason we know it has been written, as the result of an advertisement in your paper, is by the address, Church and Dey Streets, New York, which form a key to the advertisement which the J. H. McEwen Manufacturing Company had last year in THE ELECTRICAL WORLD:

ELEELE PLANTATION, KAUAI, ELEELE, August 18, 1897.

J. H. McEWEN MANUFACTURING COMPANY, Church and Dey Streets, New York:

Gentlemen—Will you kindly give me prices, f. o. b., San Francisco, on dynamo to run motor 100 to 200 horse-power, current to be carried 1 mile? Also, price of motor; also, how long before delivery could be made to San Francisco. Perhaps you may have one that has been in use before, but is in good condition. If so, please quote prices. Will you kindly send me your catalogues "A" and "B"? Yours truly, AUGUST DREIER.

If you wish to, you have our permission to publish the above. Yours respectfully, RIDGWAY DYNAMO & ENGINE COMPANY,

Cyrus Robinson, General Manager.

Business Notices.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 67-71 Park Place, New York City.

CREAMERIES IN SOUTH DAKOTA.—During the past two years the creamery industry has grown from a small beginning until at the present time there are one hundred and nineteen (119) creameries and cheese factories scattered over the State, and all doing well. Four times as many creameries are needed in South Dakota, and farmers or dairymen desiring free list showing where creameries are now located, together with othr information of value to live stock growers and farmers generally, will please address George H. Heafford, general passenger agent, C., M. & St. P. Railway, 410 Old Colony Building, Chicago, Ill.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED SEPTEMBER 21, 1897.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

590,238. ELECTRIC-ARC LAMP; W. R. Ridings, G. F. Bull and L. B. Codd, Birmingham, England. App. filed May 28, 1896. A brake mechanism for an electric-arc lamp, comprising a friction wheel, a set of toggle levers, a pad carried at the joint of the toggle levers, electromagnetic devices for operating the levers to cause the pad to clutch or engage with and leave the wheel, and connections between the wheel and the carbons.

590,263. ELECTRIC-MEASURING APPARATUS; J. C. Henry, Denver, Col. App. filed July 3, 1897. The combination with two electric motors driving a single vehicle, of two coils connected respectively to the circuits of the said motors, and a magnetic-indicating instrument acted on by both of said coils.

590,267. ELECTRIC ALARM; J. C. Kenmouth, Spearfish, S. Dak. App. filed Jan. 20, 1896. The combination with an electric circuit, a battery, an electric bell and box inclosing the same, of a plate, a strong flat spring having one end secured to said plate and electrically connected to one of said posts, a contact-point electrically connected to the other of said posts, and against which said spring normally bears, a trigger having one end suitably secured to said plate, and having a notch therein into which the end of said spring catches when it is moved and in engagement with said contact point, and a snare wire connected to the outer end of said trigger.

590,299. SIGNAL MECHANISM; J. P. Coleman, Swissvale, Pa. App. filed March 27, 1897. In a signal-operating mechanism, the combination of a signal having a bias to danger position, an electric motor, an electrically controlled connection between the motor and the signal, a circuit for the motor, a circuit breaker included in said circuit and controlled by the magnet of the connection between the motor and signal, a mechanically operated brake and a circuit breaker operated by the brake and controlling the motor circuit.

590,300. SIGNALING APPARATUS; J. P. Coleman, Swissvale, Pa. App. filed April 24, 1897. In a signaling apparatus, the combination of a signal having a bias to "danger," an electric motor for operating the signal, and an electrically controlled connection between the signal and motor, a brake for stopping the motor and adapted to be shifted to operative position by a motor-actuated part on a predetermined movement of the motor, said part being independent of the connections between the signal and the motor, and connections between signal and brake, whereby the later may be released on a movement of the signal to "danger."

590,301. SIGNALING APPARATUS; J. P. Coleman, Swissvale, Pa. App. filed May 3, 1897. In a signal apparatus, the combination of a signal having a bias to "danger," a weight for shifting the signal to clear position, a separable clutch mechanism connecting the signal and weight, an electromagnet for holding the parts of the clutch mechanism in engagement, and means for raising the weight.

590,302. SIGNALING APPARATUS; J. P. Coleman, Swissvale, Pa. App. filed May 29, 1897. In a signal apparatus, the combination of a movable signal rod adapted to be connected to a signal, a movable frame provided with a catch adapted to engage the signal rod, a magnet mounted on the frame for controlling said catch, a motor for raising said frame and means for supporting the frame in its raised position, said means being constructed and arranged to be shifted on initial movement of the motor to permit the frame to drop.

590,303. SIGNALING APPARATUS; J. P. Coleman, Swissvale, Pa. App. filed May 29, 1897. In a signal apparatus, the combination of a crank connected to a signal, a weight for rotating the crank, mechanism for controlling the rotation of the crank, an electromagnet controlling such mechanism and a motor operative regardless of the position or movement of the signal for raising the weight.

590,304. COMMON BATTERY MULTIPLE SWITCHBOARD; H. M. Crane, Boston, Mass. App. filed Aug. 9, 1897. In a telephone system, the combination of a main or sub-station circuit having plug-socket switchboard connections at a central station, and plug and switch-cord complementary connectors, each plug and cord having two main-circuit conductors looped through a current generator, with a third conductor for said plug and cord, forming a part of a local signal and test circuit also containing a source of current, and divided into two parallel branches; a relay in one of the said main conductors controlling the continuity of one of said branches and adapted when excited, to close the same; a signal switching relay in the said branch controlling the continuity of the other branch, and adapted when excited to open it; and a supervisory signal in said other branch, whereby the said signal branch is maintained open and the signal undisplayed during a conversation, but is closed and the signal displayed on the close of such conversation.

590,310. ELECTRIC RAILWAY; R. M. Hunter, Philadelphia, Pa. App. filed Sept. 12, 1897. In an electric railway, an electrically propelled vehicle having a frame supported upon the axles or axle boxes independently of the springs supporting the car body in combination with a horizontal movable collector arm hinged thereto, a collector wheel journaled upon the free end of said arm, and a working conductor upon which said collector wheel runs.

590,373. INTERIOR CONDUIT FOR BUILDINGS; H. G. Osburn, Chicago, Ill. App. filed Nov. 1, 1895. In a cut-out or junction box, the combination with a box or casing formed of ceramic material, of metallic clips mounted thereon, and a fuse block carrying plates adapted to engage said metallic clips, binding screws being provided in connection with said plates to which the fuse wire is adapted to be secured.

590,374. INTERIOR CONDUIT FOR ELECTRICAL CONDUCTORS; H. G. Osburn, Chicago, Ill. App. filed March 23, 1896. As a new article of manufacture, stoneware insulating tubes formed in short lengths from clay suitable for the manufacture of such ware, the said clay containing large percentages of silica and alumina, and being strongly compressed when being given tubulate form, the tubes thereafter being fired at a high temperature and thoroughly vitrified throughout, whereby high insulating properties and great structural strength are imparted to said tubes.

590,386. ELECTRIC TRIP-KNIFE SWITCH; A. C. Carey, Lake Pleasant, Mass. App. filed May 24, 1895, renewed June 29, 1897. In a knife switch, the combination of binding posts and standards, contact posts arranged upon opposite sides of said standards, a tilting knife carrier comprising bars centrally pivoted to said standards and adapted to engage said contact posts alternately, a vibrating, pivoted tilting device for said knife carrier, having spring connection with said knife carrier, whereby it is returned to normal after actuating the knife carrier, and independent stops also arranged upon opposite sides of said standards and adapted to automatically engage and lock said knife carrier in either of its tilted positions, independently of the tilting device and its sliding spring connection.

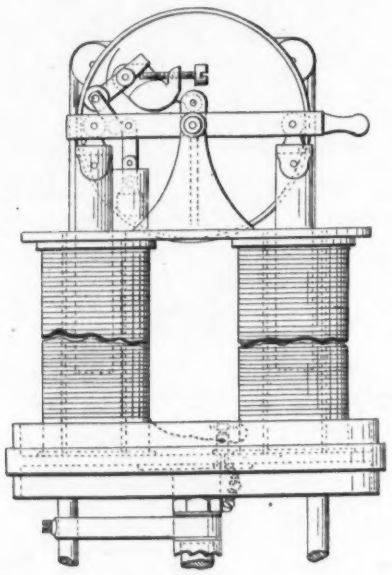
590,398. ELECTRICAL SIGNALING; S. De Jager, Paterson, N. J. App. filed Jan. 23, 1897. The combination of a transmitting device comprising means for sending a predetermined number of impulses of one polarity followed by an impulse of the opposite polarity, a main line, a source of electricity, a selecting device comprising two or more groups of magnets, contracts controlled thereby and a receiving device controlled by the contacts.

590,420. ELECTRIC RAILWAY; R. Lundell, Brooklyn, N. Y. App. filed July 18, 1896. A switch box provided with a mud groove near its top, in combination with a cover provided with two downwardly extending flanges, one of which is adapted to rest in the mud groove and the other to surround the switching mechanism when the cover is located in position.

590,466. COMMUTATOR AND MEANS FOR ASSEMBLING SAME; S. S. Short, Cleveland, Ohio. App. filed July 12, 1897. In a commutator, the combination with a hub or spider, a commutator cylinder mounted thereon and an expansible ring interposed between said commutator cylinder and said hub.

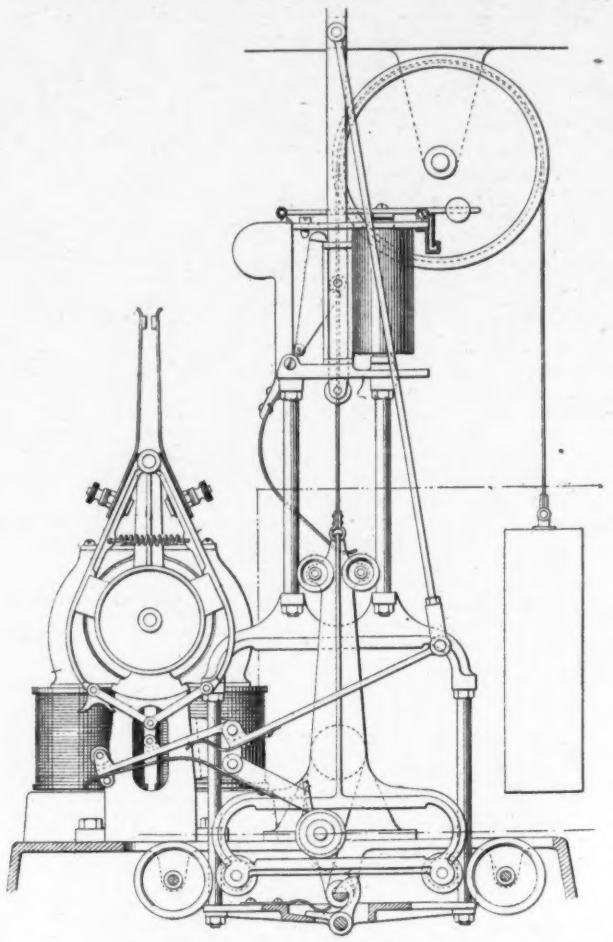
590,497. ELECTRIC IGNITING DEVICE FOR LAMPS; S. M. Meyer, Brooklyn, N. Y. App. filed April 27, 1895. The combination with a central-draft oil lamp of a high-resistance electrical conductor located adjacent to the upper end of the wick tube and attached to and supported by the air distributer.

590,504. ART OF AND APPARATUS FOR AMALGAMATING; W. A. Thacher, New York, N. Y. App. filed March 3, 1897. An amalgamating apparatus provided with an inclined amalgamated bottom plate, riffle-forming electrodes disposed transversely upon and across said plate and insulated therefrom, whereby the material operated upon falls over the upper edges of said electrodes upon said amalgamating plate, and an electric circuit having one side connected to the plate and the other to the series of riffle-forming electrodes.



No. 590,238.—Electric Arc Lamp.

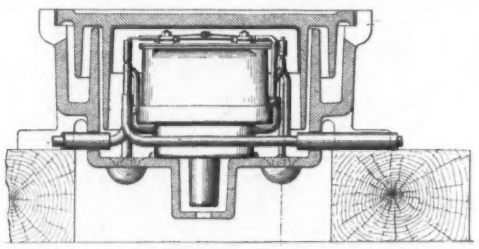
590,524. APPARATUS FOR EXTRACTING PRECIOUS METALS FROM BLACK SAND, ETC.; C. A. Hitchcock, San Francisco, Cal. App. filed March 3, 1897. An amalgamator comprising an inclined table having longitudinal side bars, an amalgamated electrode-forming plate resting on said table between the side bars, and provided on its upper face with a series of riffle bars, an upper electrode resting on said side bars and forming a cover overlying the lower electrode through its length and spaced above its riffle bars, the said riffle bars being adapted to cause the rapidly descending current to splash upwardly against the upper electrode, or form a cataract, and said cover being adapted to prevent the immediate escape of the gases generated by the electric current, and connection from the electrodes to a source of electricity.



No. 590,302.—Signaling Apparatus.

590,527. TROLLEY FOR ELECTRIC RAILWAYS; W. E. Kenway, Birmingham, Eng. App. filed May 4, 1897. The combination with cars of a double-track electric railway, and a single overhead electric conducting wire, of an inclined arm adjustably supported on such car and carrying at its outer end a vertical rod of contact maker provided with rotatable discs or buttons at top and bottom, the contact maker on the arm of the car most distant from the overhead wire being adapted to pass with a sliding or rolling motion over the contact maker on the arm of the other car when two cars are passing and pressure mechanism for preserving substantially continuous contact of the contact maker with the side of the overhead wire.

590,552. ELECTRIC RAILWAY; J. A. Roche and J. C. Bley, Chicago, Ill. App. filed April 13, 1895. The combination with a movable conductor section of supporting arms for the same, comprising pivotally supported brackets and metal arms permanently attached to the conductor section and secured to said brackets by insulating connections and contact devices for connecting the conductor sections with the supply wire, embracing stationary and movable contact pieces, rigid arms attached to the said brackets and carrying the movable contact pieces and insulated conductors attached to the metal arms of the conductor section and extending along the said rigid arms to the said movable contact piece.



No. 590,420.—Electric Railway.